

# NEC DISK DRIVE

D2362

## 9-INCH WINCHESTER DISK DRIVE PRODUCT DESCRIPTION

800mb

2.46mb/sec

4/0 960 bytes/trk

850 cyles

23 hds

806-520261-0

REV. D

PRELIMINARY

This document contains preliminary  
and incomplete information and is  
subject to change without notice  
or E.C.O.

D2362

9-INCH WINCHESTER DISK DRIVE

PRODUCT DESCRIPTION

806-520261-0

REV. D

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Printed in Japan

## PREFACE

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Specifications remain subject to change to allow the introduction of design improvements.

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# CHAPTER 1

## INTRODUCTION

### 1.1 INTRODUCTION

The NEC D2362 Disk Drive is a compact disk drive that stores 800 megabytes (MB) of unformatted data on 9-inch disk platters. The disk drive employs thin film plated platters and Winchester-type technology, which provides the most modern method of recording large amounts of data for high speed, reliable computer accessibility. (See Figure 1-1)

Table 1-1 Model Code

DESCRIPTION	MODEL CODE	PART NUMBER
9-INCH 800MB WDD BASIC UNIT	D2362-100	134-500166-100

- The D2362 Disk Drive has seven 9-inch disk platters which are sealed in an enclosure to protect the recording surface from contaminants, thus improving operational reliability. The enclosure also contains read/write (R/W) heads and a spindle with drive motor and rotary actuator assembly.
- The main components of the D2362 Disk Drive are shown in Figure 1-2 and in Table 1-2.
- Figure 1-3 shows the circuit block diagram of the D2362.
- SYSTEM CONFIGURATION

One to sixteen disk drives can be connected to one controller in a daisy chain or radial system (see Figure 1-4).

### 1.2 FEATURES

#### (1) Storage capacity

D2362 WDD serves 800 Megabytes unformatted storage capacity by using 1,070 tpi and 21,400 bpi max. recording density.

#### (2) Access time

D2362 realizes 15 milliseconds average seek time and 8.3 milliseconds average latency, and 2.46 Megabytes per seconds data transfer rate.

(3) Mounting

The 216 mm widths of a D2362 makes to mount two D2362 WDDs in a standard 19-inch rack by side by side.

(4) Maintenance

The sealed heads and disks assembly (HDA), the simplified mechanism, the direct coupled brushless DC spindle motor, and automatic velocity adjustment feature has reduced the necessity of periodic maintenance substantially.

No special tools or measuring instruments are required. A diagnostic panel is available to exercise the disk drive for seek-and-status diagnosis.

Neither electrical nor physical adjustment is required even if any kind of FRU (Field Replaceable Unit) has replaced.

(5) Reliability

D2362 ensures more than 20,000 hours MTBF which is based on the proven technic by NECs long experience of the Head-Disk interface and combined with minimized circuit components by LSI but with so flexible features of microprocessor controlled drive electronics.

(6) Availability

The auto head carriage lock feature on the D2362 realizes easy drive integration onto customers system by eliminating any kind of shipping restraint operation on the drive.

### 1.3 INTERFACE

Interface between D2362 and controller employs physically and electrically same signal lines as SMD-E interface. Details are described in Chapter 6.

### 1.4 SAFETY

The D2362 Disk Drive shall conform to the Underwriter's Laboratories Safety Regulation UL478, CSA and other regulations.



Table 1-2 D2362-100 WDD (Basic Unit) Spare Parts

FUNCTION (FRU)	DESCRIPTION	SPARE PARTS NUMBER	REMARKS
"POWER AMP"	SPARE G9WBU PWA	134-530339-002	Repairable
"ENDEC & R/W"	SPARE G9WCK PWA	134-530354-001	Repairable
"LOGIC & SERVO"	SPARE G9WCL PWA	134-530355-001	Repairable
└ MPU FIRMWARE	SPARE 2764 WCL02xx PROM	134-530368-001	
"COOLING-FAN"	SPARE 747 DC-FAN	134-530356-001	
"BRAKING RELAY"	SPARE 747 RELAY	134-530357-001	
"HEAD-DISK ASSY"	SPARE 752 HDA	134-530365-001	Repairable
└ DISCHARGE PAD	SPARE 747 CONTACT PAD	134-530359	
└ MOTOR STATOR	SPARE 747 STATOR	134-530360	

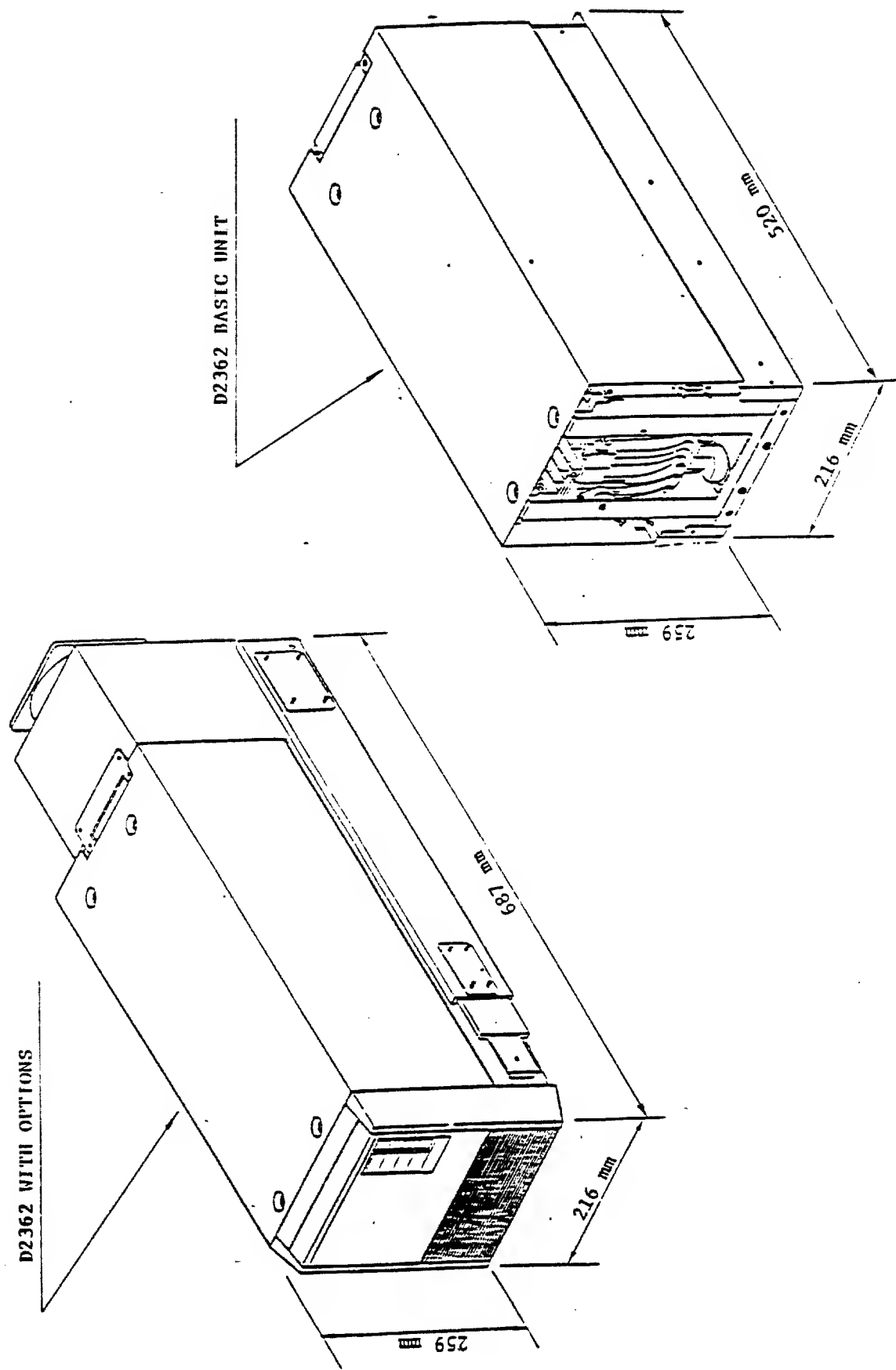


Figure 1-1 D2362 Appearance

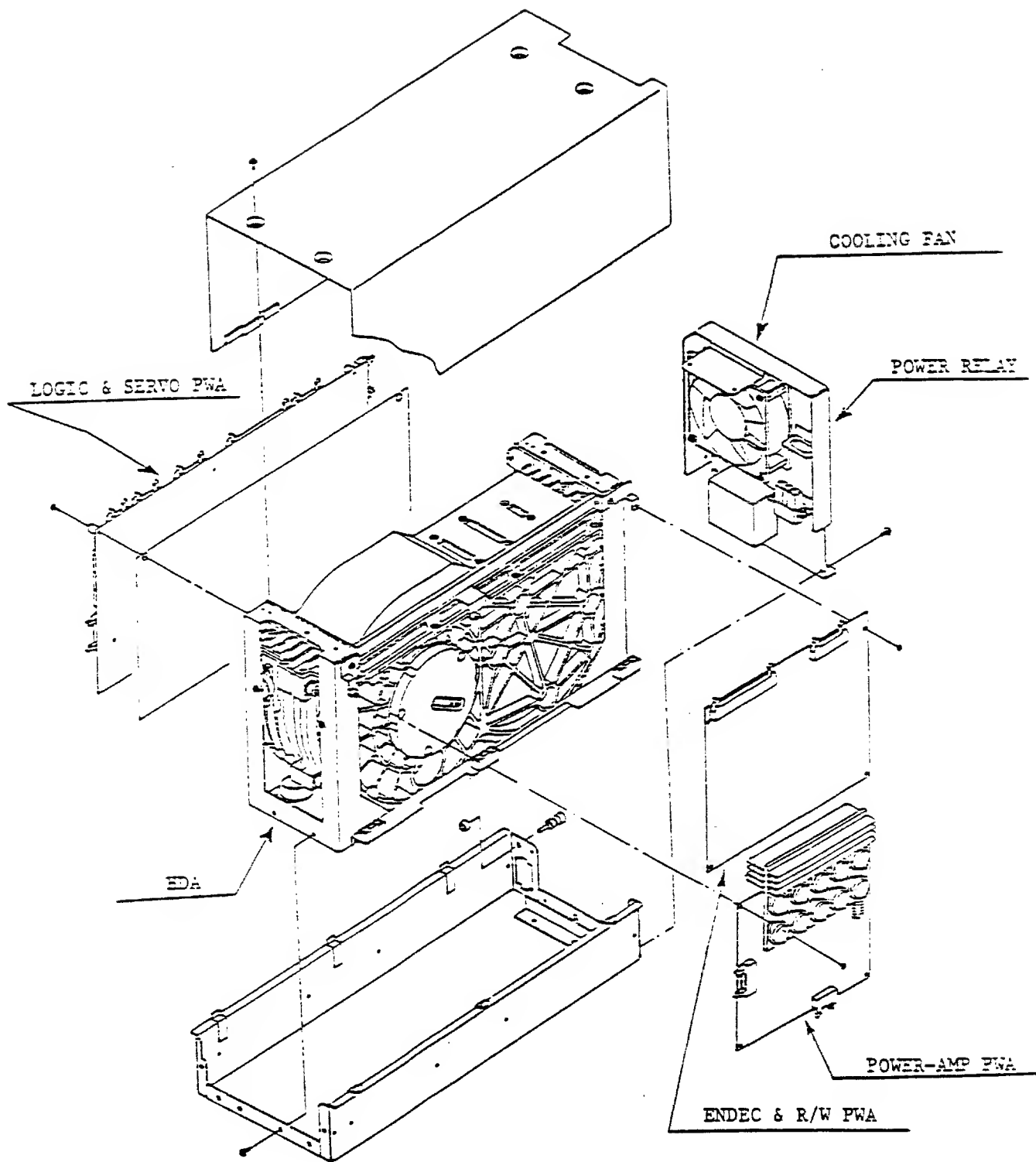


Figure 1-2 Major Components of the Basic Unit



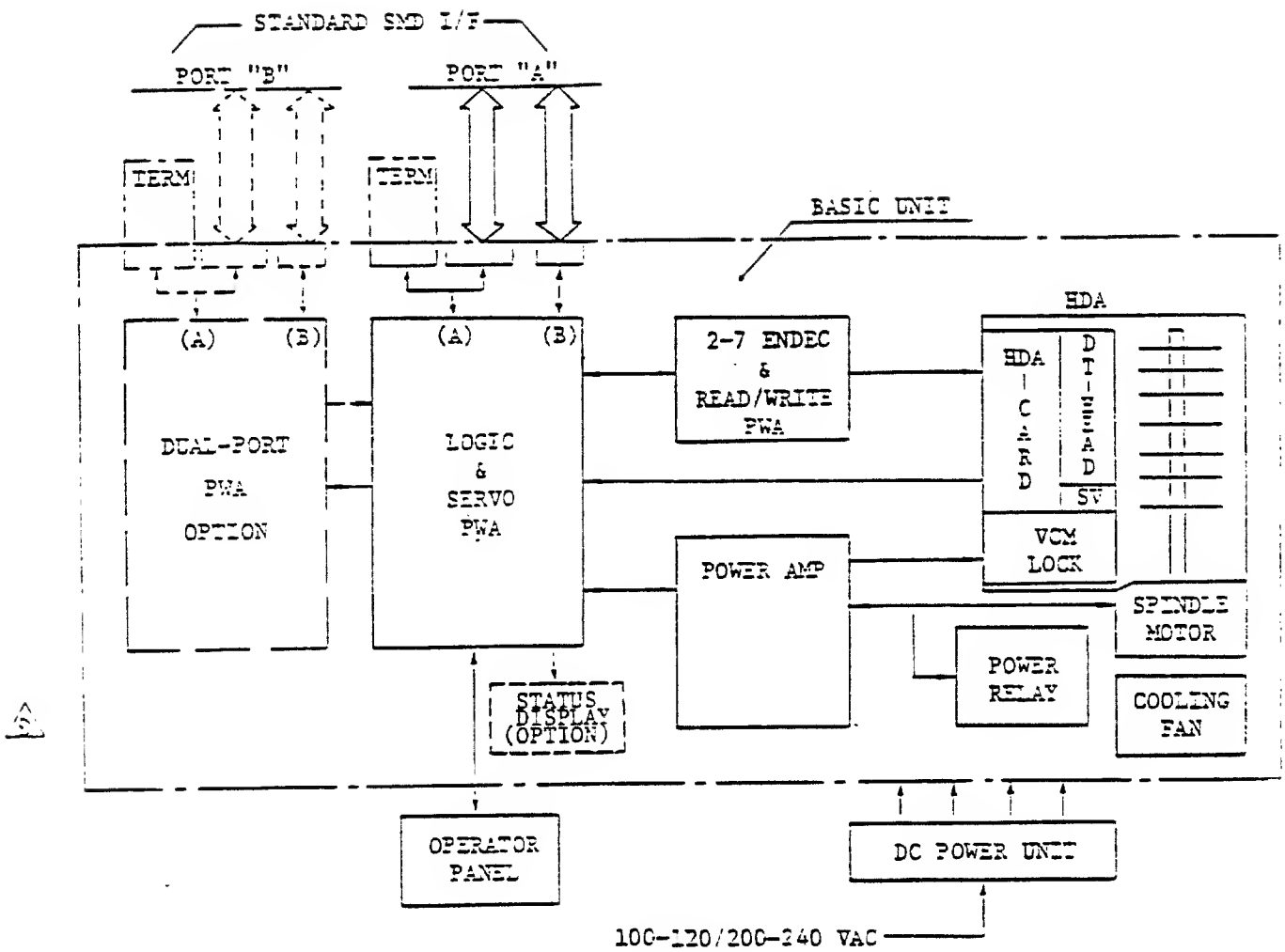
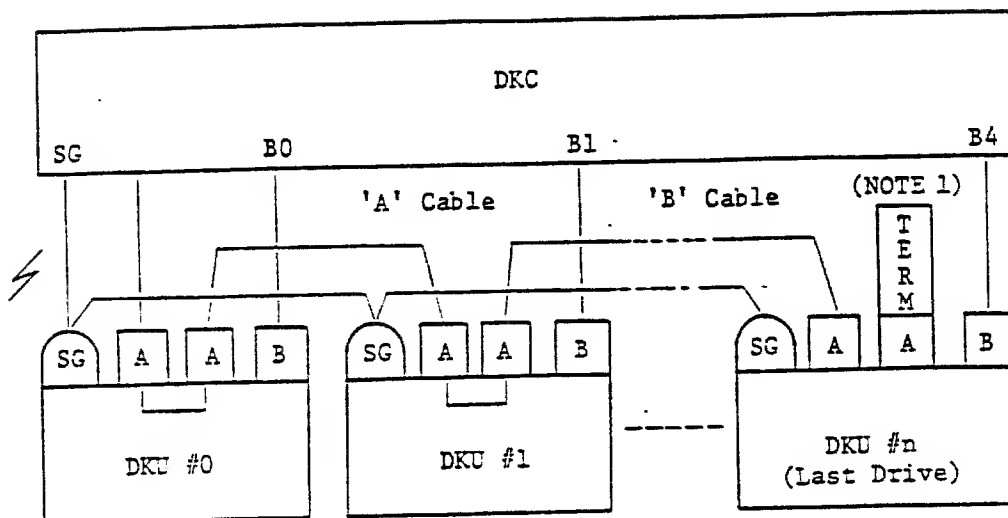
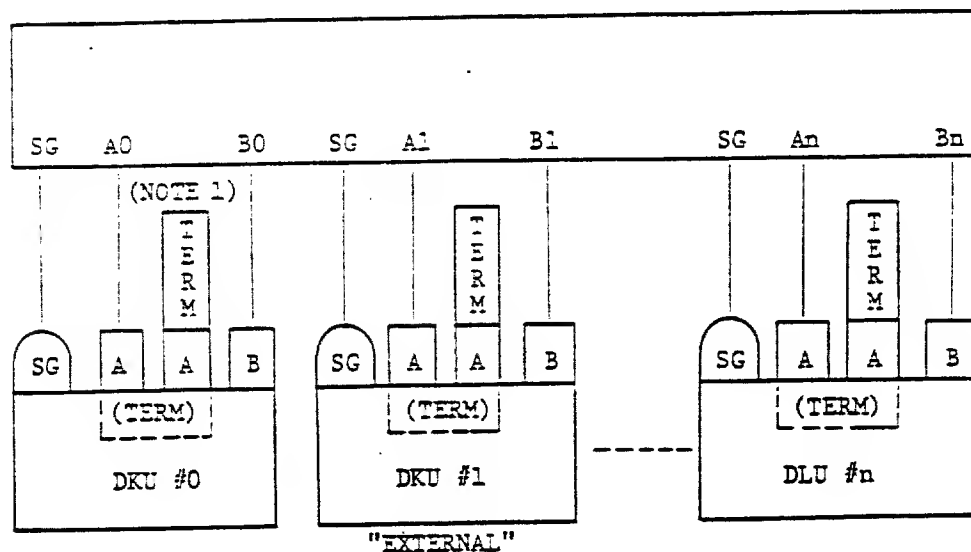


Figure 1-3 Block Diagram

(A) DAISY-CHAIN: MORMAL TERMINATION (LAST DRIVE ONLY) MODE



(B) RADIAL (=STAR) CONNECTION



NOTE 1) TERM = Terminator : Normaly 56 (ohm)

A cable max. length is 30m (100 feet)  
B cable max. length is 15m ( 50 feet)

Figure 1-4 Examples of Interface Connection Configurations (Single Port)

## 1.5 OPTIONS

The available options for the D2362 Disk Drive are listed in Table.

Table 1-3 Options & Accessories

Option	Description
External Terminator	A 60-PIN 56-ohm resistor module for Cable A signal termination from outward of the disk drive.
Dual Port Option	Enables interfacing with two controllers for disk drive.
Front Panel Option	Consist of front panel and operator panel. There are START/STOP switch/LED, READY LED, PROTECT switch/LED and Fault switch/LED.
Power Supply	Supplies all the DC voltages to the Disk Drive from AC Input power.  Input; 100 - 120VAC/200 - 240VAC 50/60Hz (Universal)
AC-Power-Cord	Feeds AC-Input to the Power supply.
DC-Extension Cable	A power cable connecting between the disk drive and the Power Supply when the Power Supply located separately from the disk drive.
Slide Rails Option	Enables pulling out the drive for easy maintenance.
Mounting Hardware	Maximum two disk drives are able to be installed in a 19-Inch rack by side by side.
Status Display Panel	Status Display Panel indicates the Drive operation Status by two hexadecimal seven segment Display.
Diagnostic Panel	Applies error-logging and seek function testing (Exclusive to STATUS DISPLAY)

Table 1-4 D2362 Options Configuration

ITEM	FUNCTION	PRODUCT CODE	PART NUMBER	QTY
1	56-ohm External Terminator	747-ETR External Terminator	806-944644-001	1
2	Dual Port Option Without O.B.T.R. (NOTE 1)	752-DPA Dual-Port Option	134-501247-001	1
3	Front Panel Option	752-FP Front Panel	134-501251-002	1
4	Power Supply	752-PS (NOTE 2) DC-Power Supply	134-501252-001	1
5	AC-Power Cord	120V-60Hz PC AC Power Cord	806-943295-101	1
6	DC-Extension Cable (5 feet)	747-DC5 DC Extension Cable	134-501078-150	1
7	Slide Rails	747-SR Slide Rails Kit	134-501080-001	1
8-1	10.5" PITCH Mounting Hardware	747-6U MK Mount Kit	134-501036-003	1
8-2	11" PITCH Mounting Hardware	747 (7U) MK Mount Kit	134-501031-003	1
9-1	Status Display Panel	SD231 STATUS DISPLAY	134-531201-001	1
9-2	Diagnostic Panel	747-HLOG Diagnostic Panel	134-530649-001	1

NOTE 1: O.B.T.R. = On-Board Termination Resistors.

NOTE 2: 747-PS (134-501030-001) also usable.





## CHAPTER 2

### SPECIFICATIONS

This chapter describes the general performance, physical design, and environmental conditions necessary for proper use.

#### 2.1 GENERAL PERFORMANCE SPECIFICATIONS

The general performance specifications of the D2362 Disk Drive are listed in Table 2-1.

#### 2.2 SPECIFIC PERFORMANCE SPECIFICATIONS

Table 2-2 lists specific performance specifications of the D2362 WDD.

#### 2.3 PHYSICAL SPECIFICATIONS

The dimensions of the D2362 Disk Drive without option (=Basic) and with options are shown in Figures 2-3 and 2-4.

The interface connectors are shown in Figure 2-5.

#### 2.4 RELIABILITY

2.4.1 Reliability of the disk drive is measured by such factors as meantime-between-failures (MTBF), mean-time-to repair (MTTR), error rate, and media defects. The MTBF is more than 20,000 hours. The MTTR is less than half an hour.

##### 2.4.2 Preventive Maintenance Time

No scheduled maintenance is required.

##### 2.4.3 Service Life

The D2362 drive provides a useful life of five (5) years or 20,000 hours in power on time.

##### 2.4.4 DC Power Loss

Data integrity is assured in the event of a power loss (data is not assured during write operation).

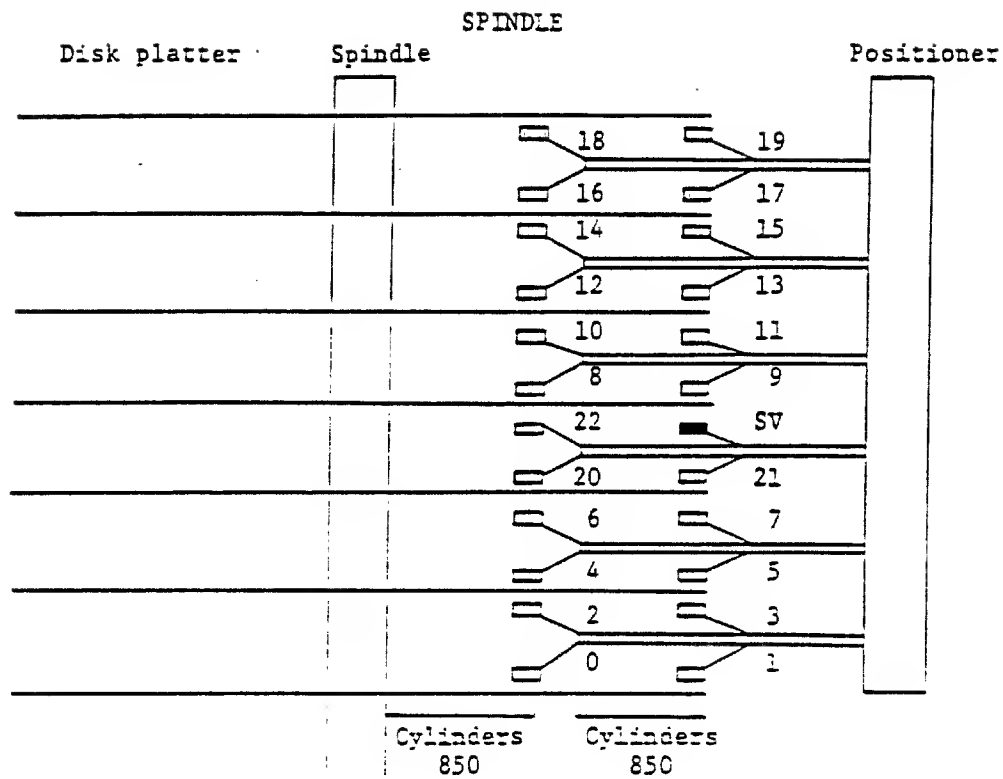
Table 2-1 General Performance Specifications

FEATURE	SPECIFICATION
General	
Start Time	Less than 20 seconds
Stop Time	Less than 15 seconds
Recording Mode	2-7 Run Length Limited Code (2-7 RLL)
Interface Mode	Nonreturn-to-zero (NRZ)
Head Positioning	Closed servo rotary actuator with track-following method using a Modified-Dipulse pattern.
* Basic Power Requirements (Without any option)	
Refer to Chapter 3 with detail specification for Basic Power Requirements	
Environmental	
Temperature (Ambient)	
Operating	10°C to 40°C
Nonoperating	-10°C to 50°C
Storage (**1)	-40°C to 60°C
Temperature Gradient (max.)	
Operating	10°C/hour (18°F/hour)
Nonoperating	10°C/hour (18°F/hour)
Storage (**1)	25°C/hour (45°F/hour)
Relative Humidity (without condensation)	
Operating	20% to 80% RH
Nonoperating	8% to 90% RH
Storage (**1)	5% to 95% RH
Vibration	5Hz - 50Hz : 50Hz - 500Hz
Operating	Max. 0.2G      Max. 1G
Nonoperating	Max. 0.5G      Max. 1G
Storage (**1)	Max. 5G      Max. 5G
Shock	
Operating	2G (20 ms)
Nonoperating	5G (10 ms)
Storage (**1)	15G (20 ms)
Altitude	
Operating	3,000 m (10,000 feet)
Nonoperating	12,000 m (40,000 feet)
Storage (**1)	12,000 m (40,000 feet)

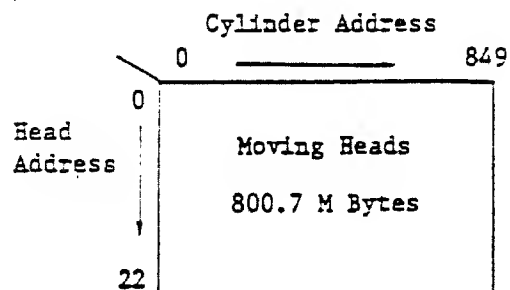
\*\*1 "Storage" or      Specific Air-Sealed Packaging requested.  
transportation: Refer to Figure 2-10.

Table 2-2 Specific Performance Specifications

FEATURE	SPECIFICATION	REFERENCE
	D2362	
UNFORMAT CAPACITY		Figure 2-1
Per DRIVE (M-BYTES)	800.7	
Per CYLINDER (BYTES)	942,080	
Per TRACK (BYTES)	40,960	
HEADS PER CYLINDER	23	
CYLINDERS PER DRIVE	850	
DATA TRANSFER RATE (KB/S)	2,458	
ROTATIONAL SPEED (RPM)	3,600	
AVERAGE LATENCY (msec)	8.3	
SEEK TIME (msec)		Figure 2-2
ONE-CYLINDER SEEK	5	
AVERAGE SEEK	15	
MAX-CYLINDER SEEK	27	
TRACK DENSITY (TPI)	1,070	Figure 2-1
BIT DENSITY (Max bpi)	21,400	
Number of Disk	7	
Number of Data Heads	23	Paragraph 4.5.3
Number of Servo Head	1	
Sectors/Track	Can be selected are: 1, 2, 3, ..., 128 and VARIABLE WITH AM FUNCTION	
MECHANICAL DIMENSION & WEIGHT		Figure 2-3
BASIC UNIT (mm)	259H x 216W x 520D, 30kg (10.2" x 8.5" x 20.5")	
WITH OPTIONS (mm)	259H x 216W x 687D, 37kg (10.2" x 8.5" x 27.4")	Figure 2-4



(a) Physical Configuration



(b) Logical Track Address Map

Figure 2-1 Disk/Head Configuration

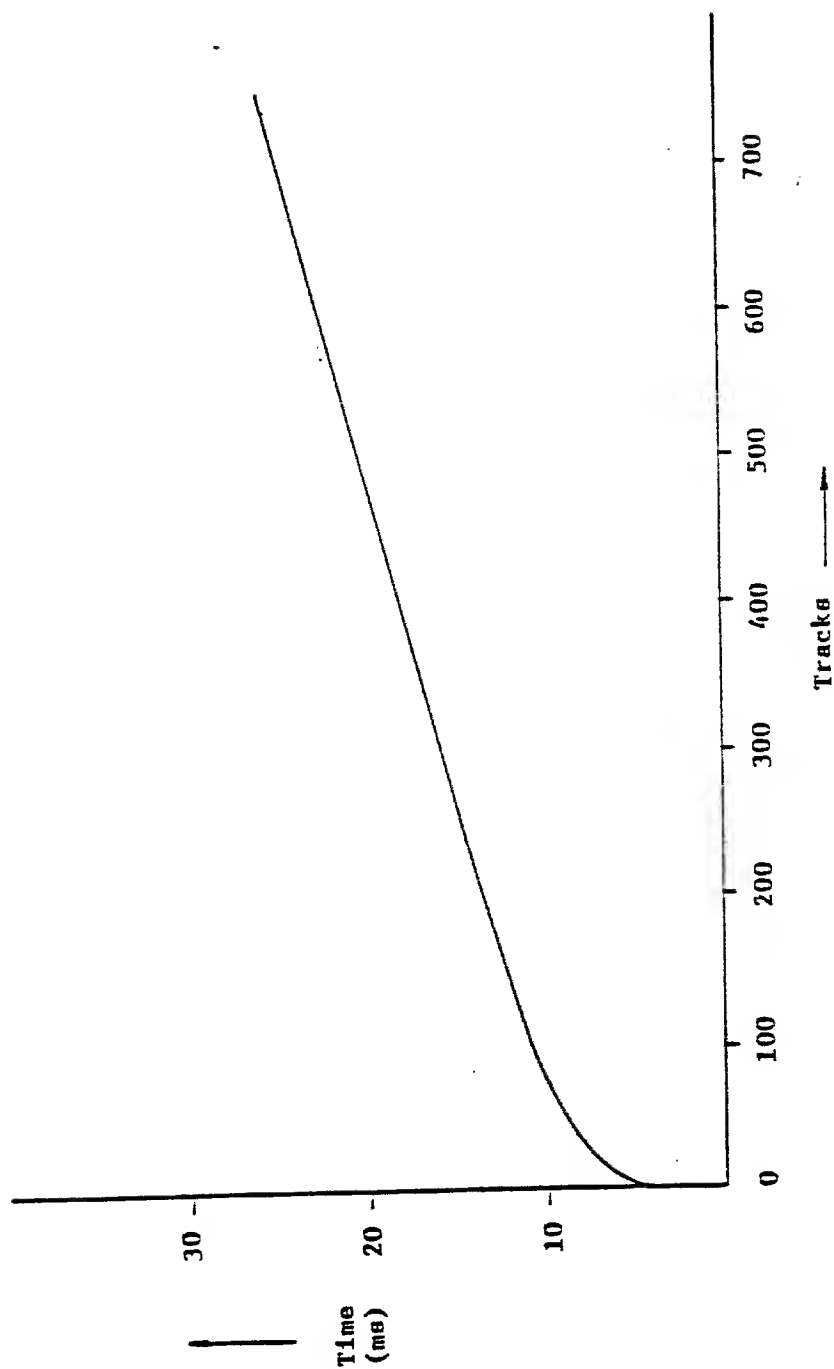
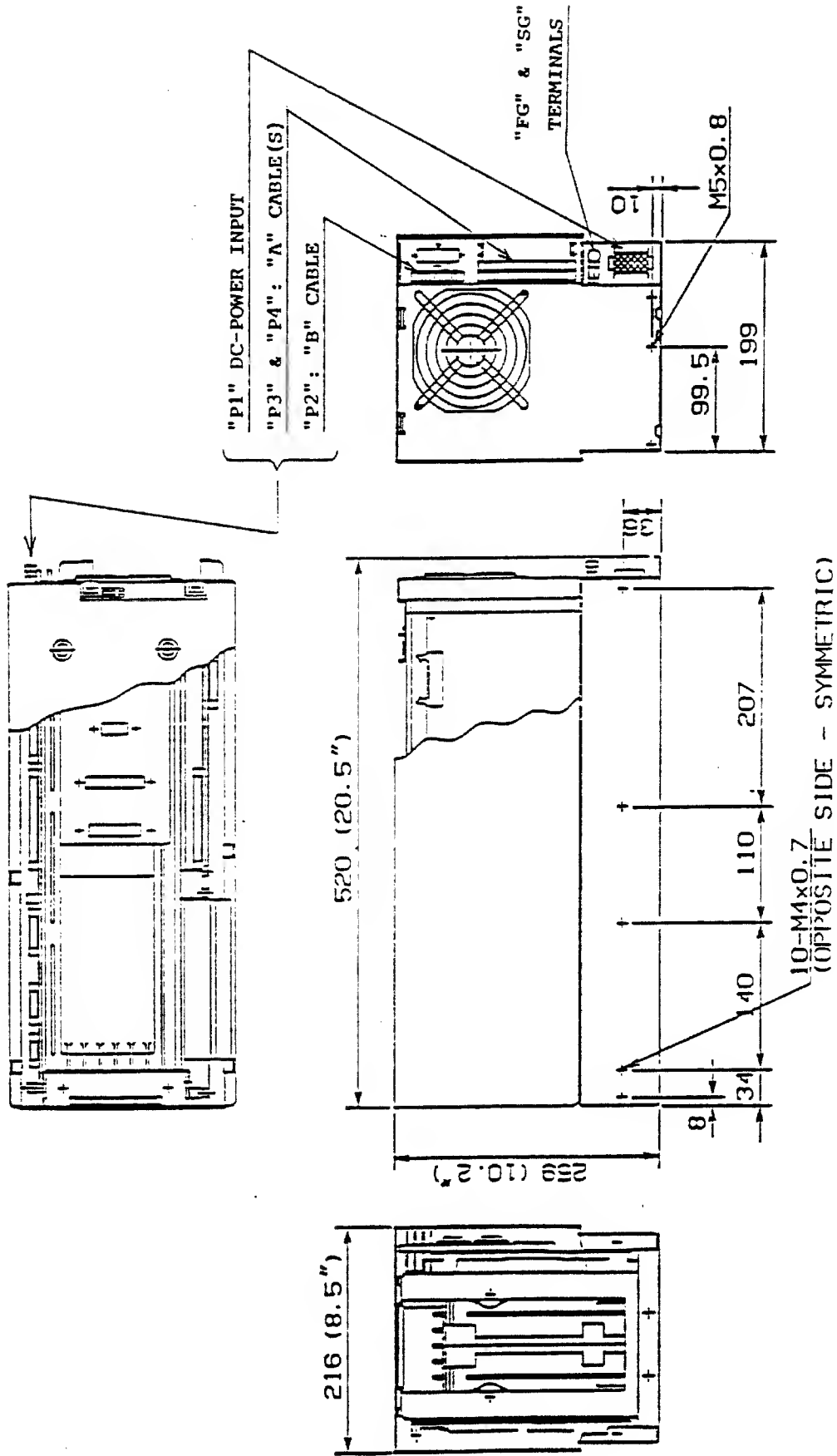
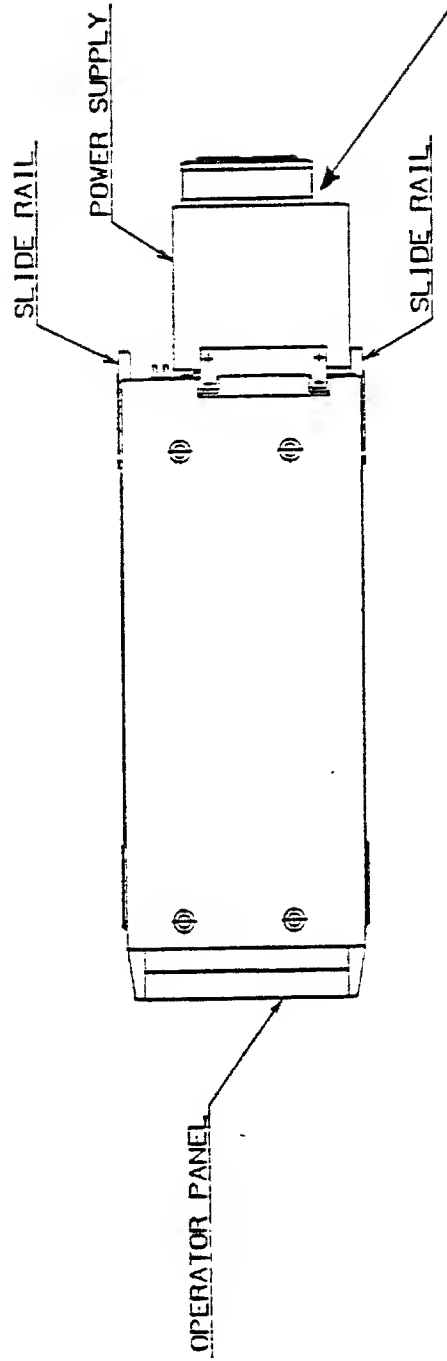


Figure 2-2 Seek Time Profile



UNIT :MM (INCH)

Figure 2-3 D2362 Basic Unit



UNIT :MM (INCH)

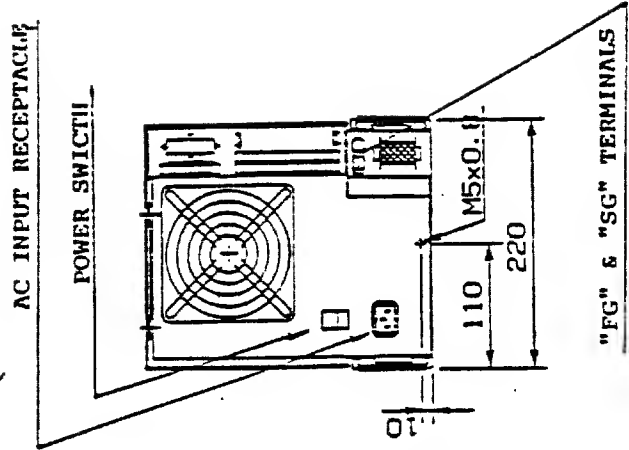
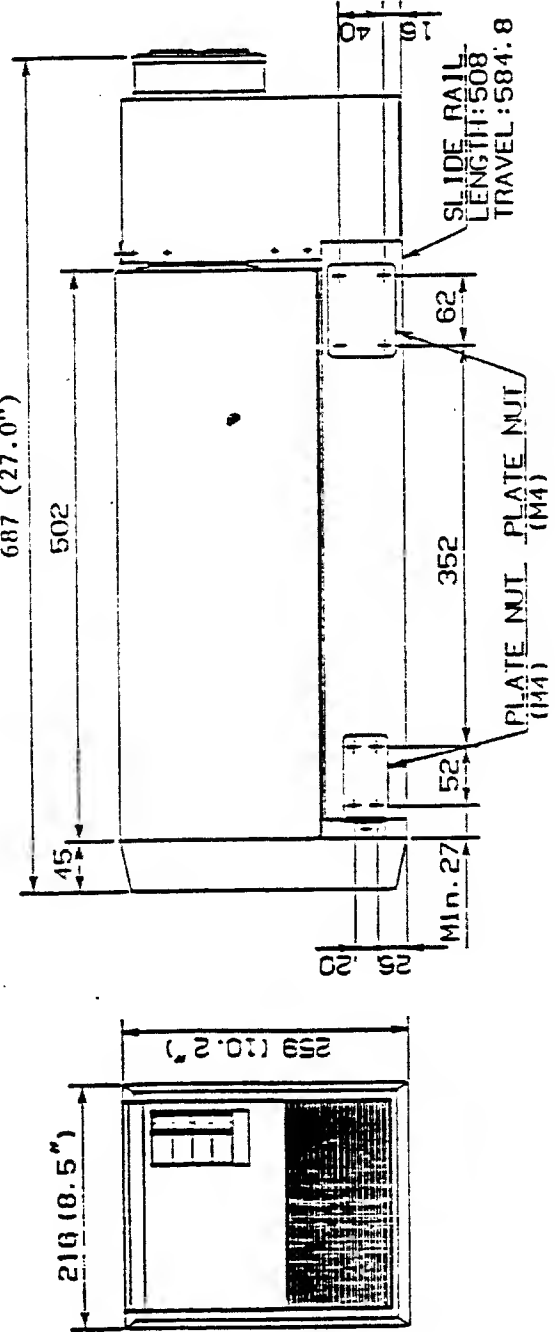


Figure 2-4 D2362 With Options

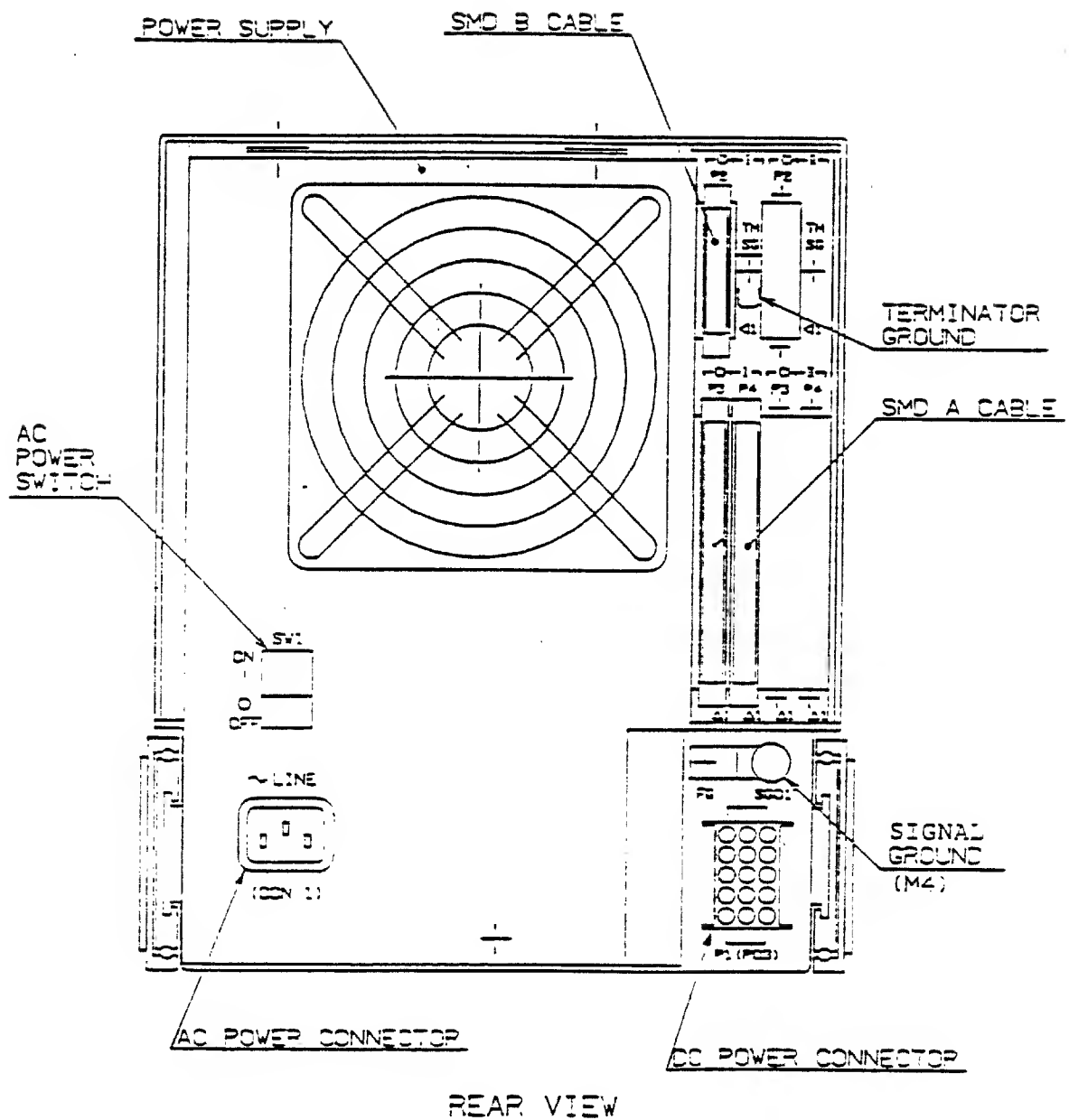


Figure 2-5 I/O Connector Location (Basic Unit and Power Supply)



## 2.5 DATA INTEGRITY

The following error rates assume that the D2362 is being operated within specification. Errors caused by media defects or equipment failures are excluded.

### 2.5.1 Read Errors

Prior to determination of a read error rate, the data shall have been verified as written correctly and all media defects flagged.

#### (1) Recoverable Error Rate

A recoverable read error is one which can be read correctly within 15 retries (including servo offset and marginal data strobe mode) and less than ten per  $10^{11}$  bits. (Read Retry Procedure is shown in Figure 2-6).

#### (2) Unrecoverable Error Rate

An unrecoverable read error is one which cannot be read correctly within 15 retries (including Servo offset and marginal data strobe mode), and less than ten per  $10^{14}$  bits.

### 2.5.2 Seek Error

The seek error rate is less than one in  $10^7$  seeks.

⚠  
⚠

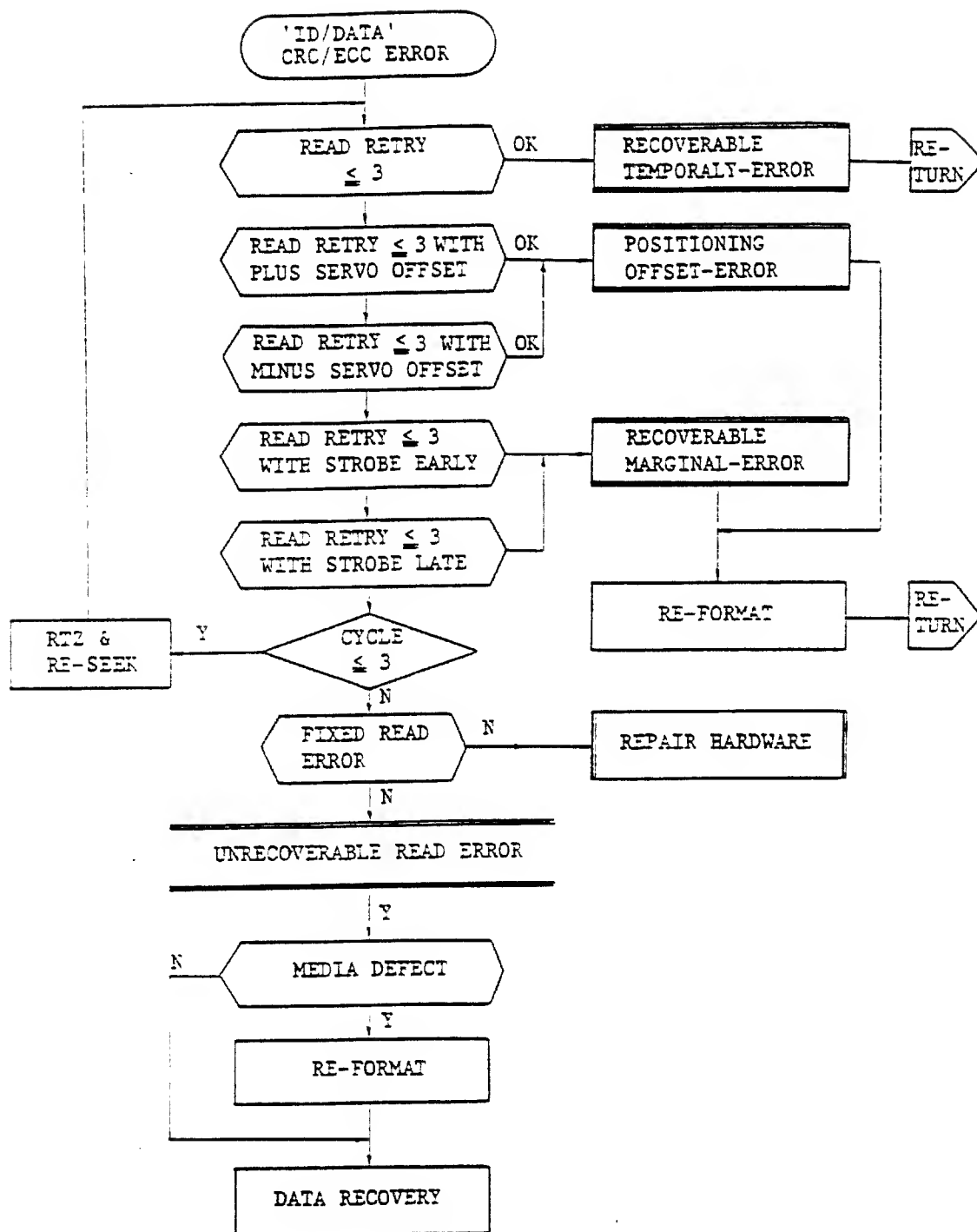


Figure 2-6 Read Retry Procedure

## 2.6 MEDIA DEFECTS

A media defect is a physical characteristic of the media which results in a repetitive read error when a properly adjusted unit is operated within specified operating conditions. Valid data must not be written over known media defects; therefore sector/track deallocation or skip displacement techniques must be utilized.

### 2.6.1 Definition of Track Quality

Every track is classified into three grades dependent on number of defects on a track. They are:

Perfect track: A track containing no defects  
Good track : A track containing one defect  
Defective track: A track containing two or more defects, or a track containing flaws which may contribute to missing Address Mark (AM) or false Address Mark (AM).  
If the track is defective, the high order bit of the first cylinder byte in the Header is set to one.

### 2.6.2 Quality Standards of Media at Shipment

D2362 disk drive is checked for presence of media defects before shipped from the factory.

- The maximum number of media defects in the HDA is TBD.
- The maximum number of defective tracks in the HDA is TBD.
- Head 0, 1 and 2 at cylinder 0 are perfect tracks.

### 2.6.3 Media Defect Logging Information

The drive will have a flaw map attached which will list the following information (decimal notation):

1. Head
2. Cylinder
3. Location (bytes from Index to the beginning of the defect)
4. Length (bits)

In addition, the drive will be formatted at the factory with the Standard Media Defect Format (Note 1).

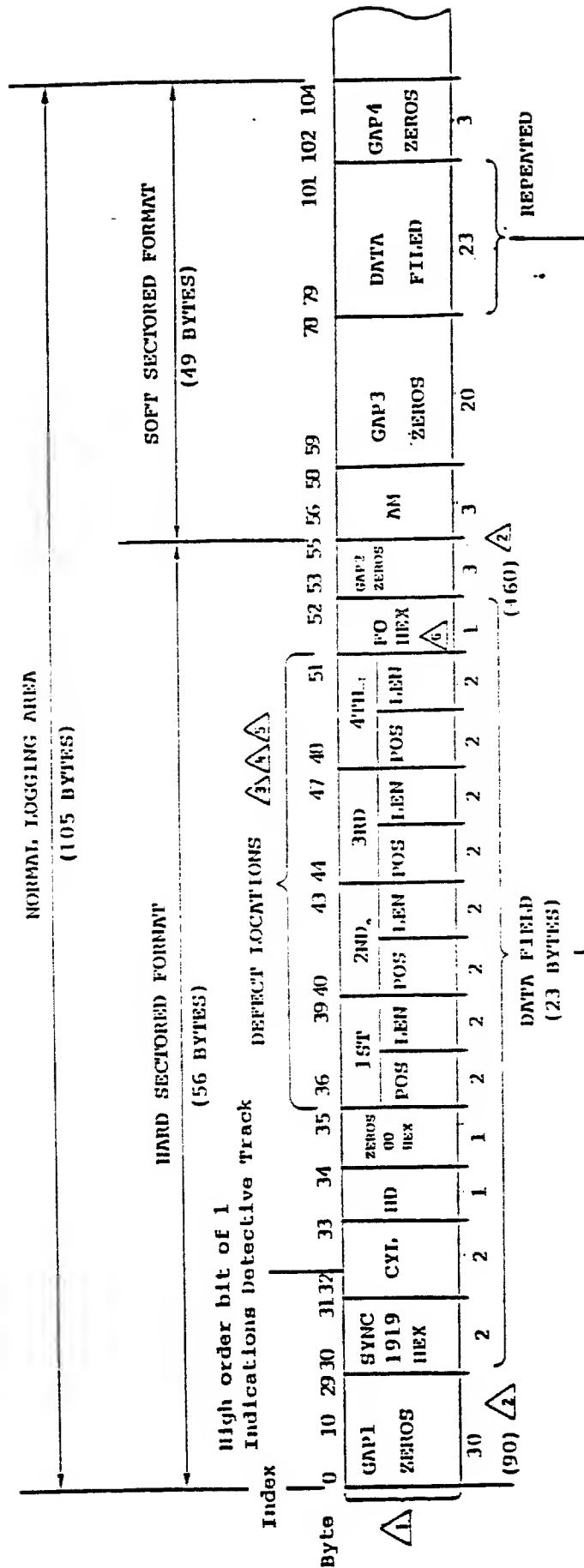
Note 1. The format is so called as External Format ("EXF")

#### 2.6.4 Media Defect Format

The drive will be formatted at the factory with Standard Media Defect Format. The media Defect Format is divided into two parts. The first part is a hard-sectored format (sectored format) and is normally included in the first 56 bytes following Index signal. The second part is a soft-sectored format (address mark format) and is normally included in the next 49 bytes following Index signal as shown in Figure 2-7 (MEDIA DEFECT FORMAT (BASIC)).

#### 2.6.5 Format Rules (Refer to Figure 2-7)

1. More than one defect on a track causes it to be flagged as a defective track (see Rule 4). The first four media flaws are logged. Additional media flaws will not be recorded but will be indicated by a Hex "FF" written in the byte following the fourth defect length.
2. If the beginning of a defect is located between 15 and 56 bytes after Index, 60 bytes of zeros are added to gap 1 (90 bytes total). In this case, if any part of a defect is between bytes 70 and 165, the track is flagged defective. Refer to Figure 2-8 Format-A.
3. If the beginning of a defect is between 56 and 106 bytes after Index, 60 bytes of zeros are added immediately before the address mark. In this case, if any part of a defect is between bytes 116 and 155, the track is flagged defective. Refer to Figure 2-9 Format-B.
4. If a defective track is established according to Rules 1, 2, or 3 above, the high order bit of the first cylinder bytes is set to 1. Remaining information may or may not be valid.



NOTES:

- 1 DATA IS BINARY. OTHER NUMBERS ARE IN BYTES.
- 2 DEFECT SKIPPED.
- 3 UNUSED DEFECT LOCATIONS ARE ALL ZEROS.
- 4 POSITION OF DEFECT IS IN BYTES AFTER INDEX 11 BYTE.
- 5 LENGTH OF DEFECT IS IN BITS 11 BIT.
- 6 IF MORE THAN 4 DEFECTS, HEX FF WILL BE WRITTEN.

Figure 2-7 Media Defect Format (Basic)

Index

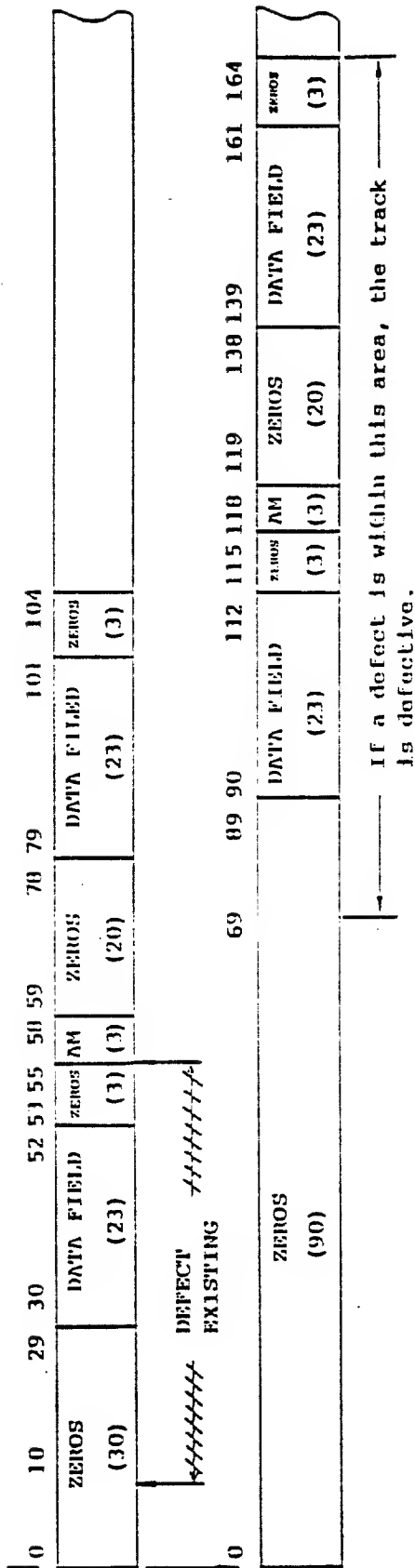


Figure 2-8 Skip Displaced Format-A

Index

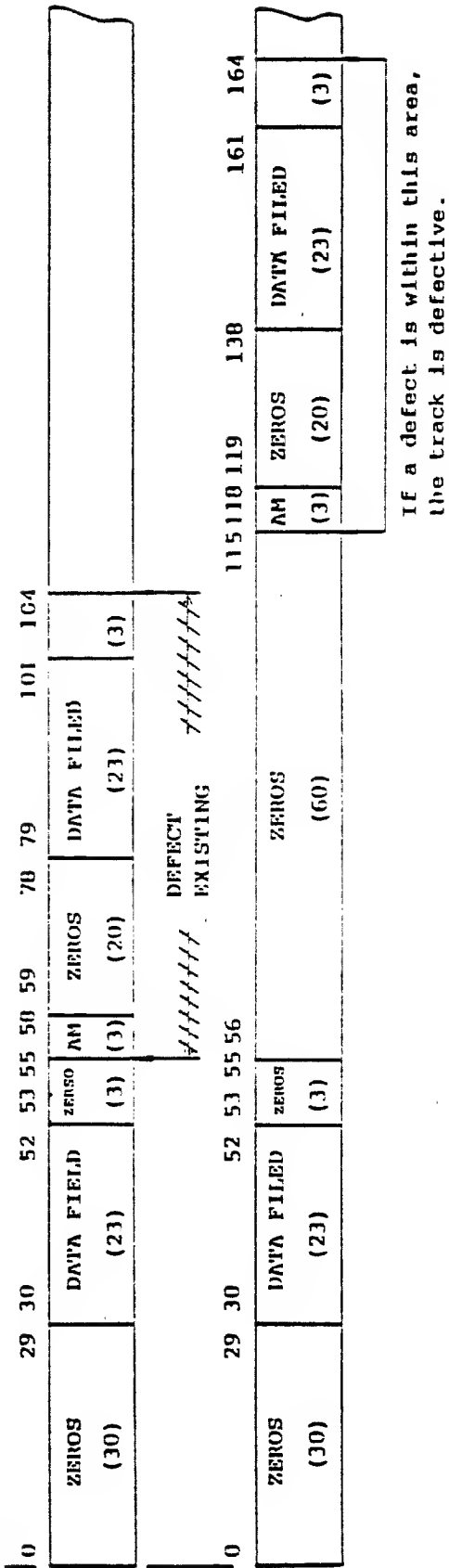


Figure 2-9 Skip Displaced Format-B

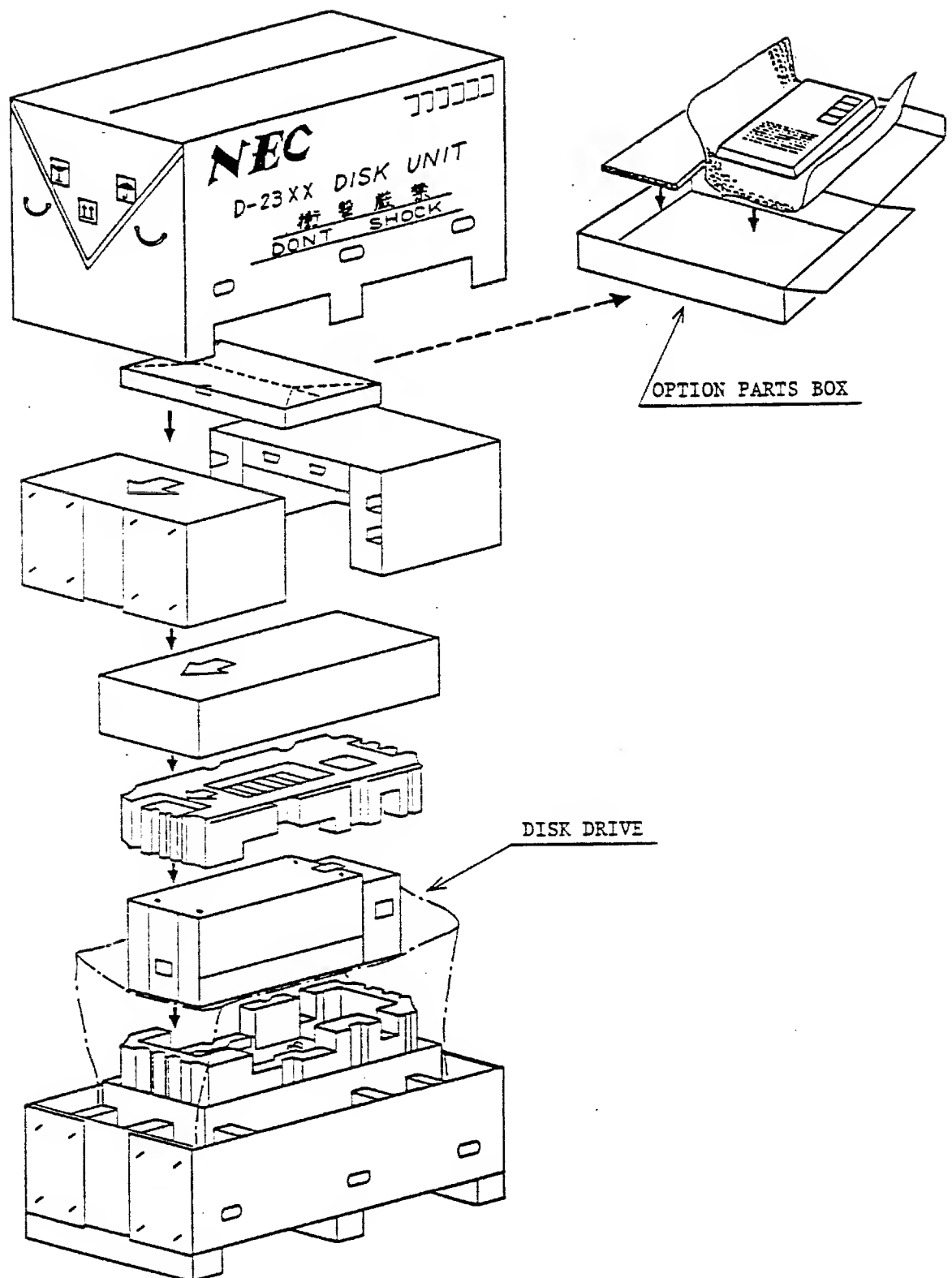


Figure 2-10 Shipping Packaging





# CHAPTER 3

## POWER REQUIREMENT

One of AC-Input power or a set of DC-Input power is required for the D2362 Disk Drive operations.

### 3.1 DC-POWER REQUIREMENT (D2362 BASIC UNIT)

The dc power must meet the noltage specifications shown in Tables.

Table 3-1 Basic DC Power Specifications

VOLTAGE (Volts-dc)	TOLERANCE (±Volts-dc)	CURRENT (amperes)	RIPPLE (Mullivolts-p-p) (@DC-50 MHz)
+5.0	0.25	3.5	100
-5.2	0.25	3.5	100
+12.0	0.60	1.0	100
-12.0	0.60	1.0	100
+38.0	3.8	3.5 average (running current) 10 peak pulse (starting current)	300

Table 3-2 Power Dissipation and Heat Generation (Basic)

DESCRIPTION	WATTS/Kcal.
Power dissipation	193 Watts running 250 Watts starting*
Heat generation	160 Kcal./hour
* Duration: 15 seconds or less	

Table 3-3 Power Input Damage Threshold Voltage

DC VOLTAGE	THRESHOLD
+5.0	+/-25%
-5.0	+/-25%
+12.0	+/-25%
-12.0	+/-25%
+38.0	+/-25%

### 3.2 DC Power Connector (Basic)

- (1) The DC power connector (P1) front view is shown in Figure 3-1. The P1 pin assignments are listed in Table 3-4.

"P1" PIN LOCATION

Table 3-4

HOUSING AMP P/N: 1-480711-C  
 CONTACT AMP P/N: 350550-1

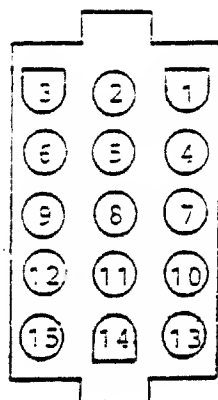


Figure 3-1

PIN NO.	LINE ASSIGNMENT
1	+5V
2	GND
3	-5.2V
4	+5V
5	GND
6	-5.2V
7	-12V
8	GND
9	-12V
10	+38V
11	GND (38V RTN)
12	(-2.2V): NOT USED
13	+38V
14	GND (38V RTN)
15	RESET (MAKE-GND)

# 38V CURRENT DETAIL

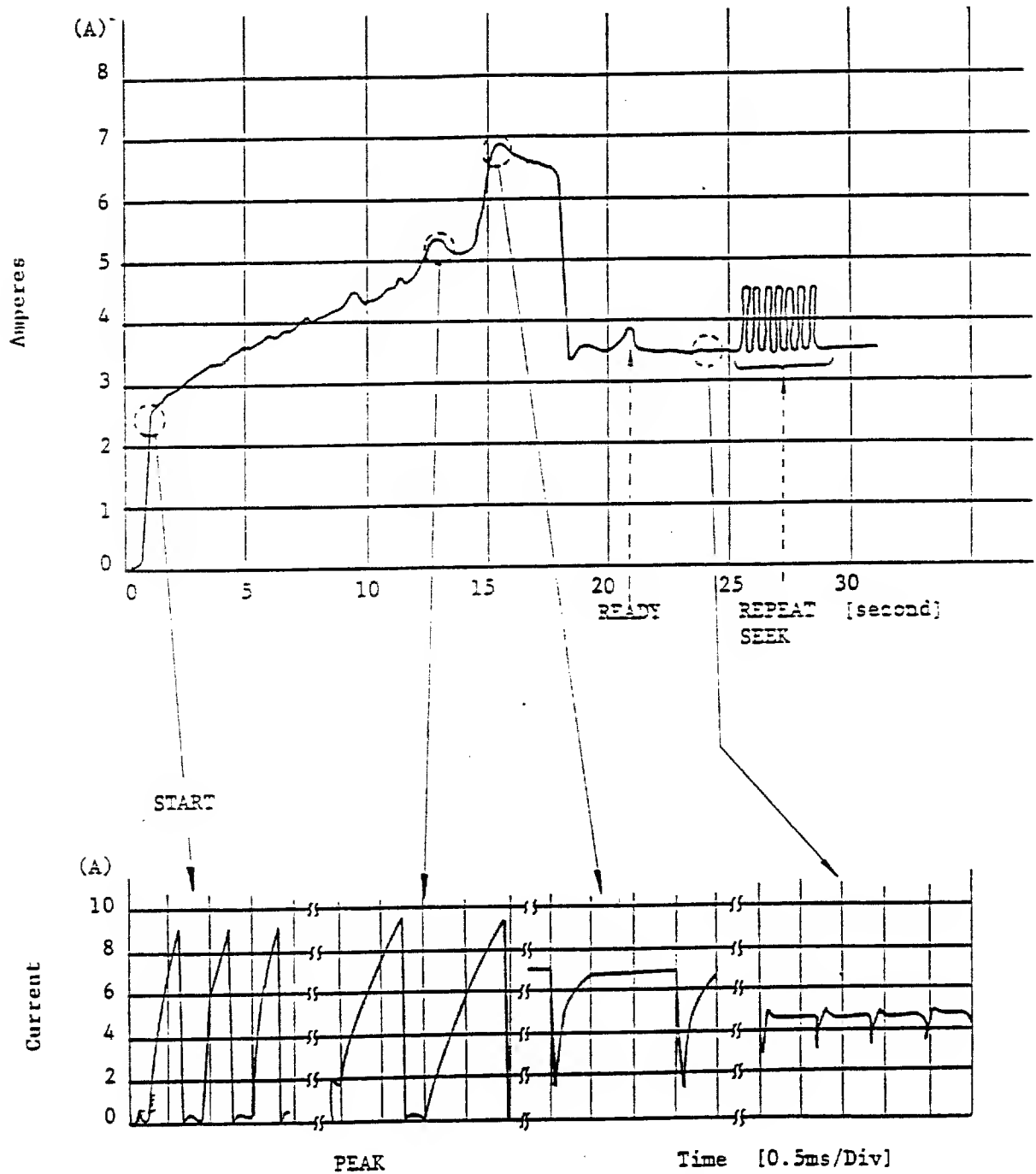


Figure 3-2 +38V Load Current Characteristic

### 3.3 POWER SEQUENCE REQUIREMENT

The D2362 Disk Drive has a voltage detecting circuit for check the voltage of DC power input (described in 3.1). At a normal condition this circuit usually supervises each voltage level on DC input line and if any Loss of Voltage occurs, it enables a FAULT status of "DC UNSAFE" and executes a Data Protect operation.

At a power on stage, transient "LOSS OF VOLTAGE" may occurs. In this case, the "FAULT" shall not be detected.

The Disk Drive can carry out a normal power up sequence with any of the following two Power-On-Initialize method.

#### 3.3.1 With Power On Reset Signal

The DC Power Input Connector of this Disk Drive includes a control signal line.

15-PIN of the "P1" Connector is the control signal line "RESET". The starting of a Power On Reset sequence from an external sequence controller is enabled by closing contact between this 15-PIN and a "GND" PIN.

The reference of voltage establishment/descending on each power lines to the sequence timing of the "RESET" signal line during power-on and off is shown in the Figure 3-3.

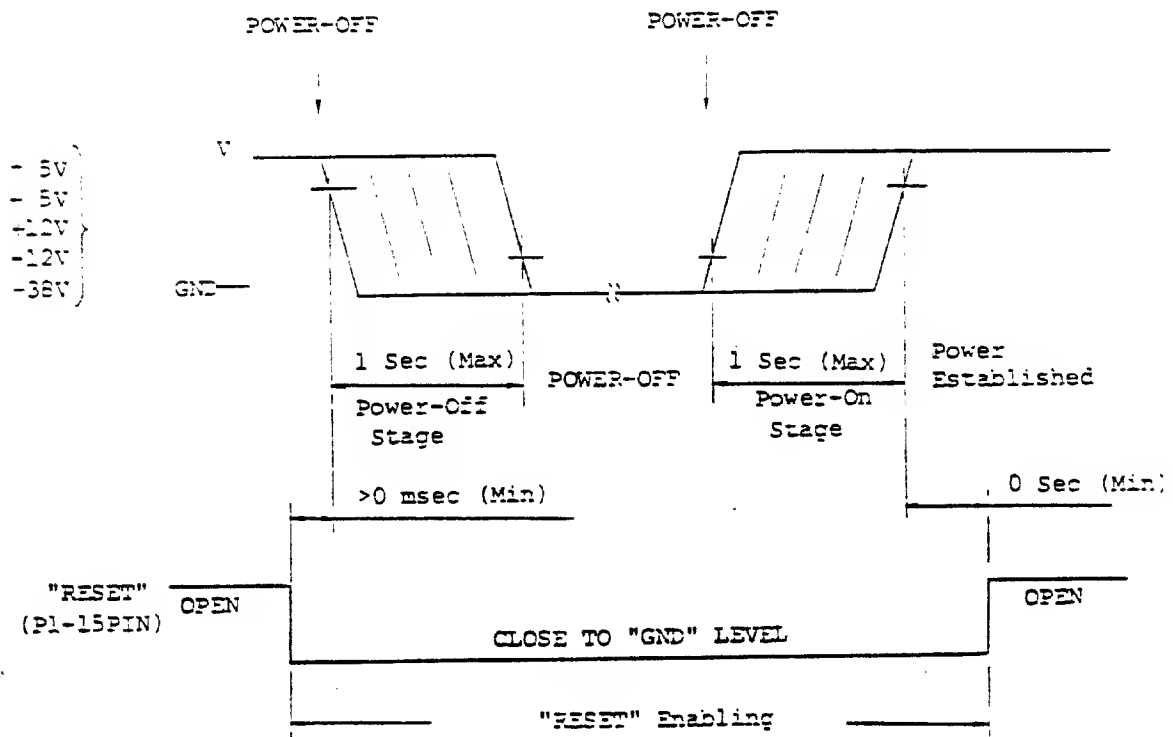


Figure 3-3 Power On Sequence by "RESET" Control

### 3.3.2 Power On Sequence Without "RESET" Control

Prescribed DC power applying shall be kept the following conditions.

- (1) Power on Initialize - Power-on-Reset operation is enabled around 500 milliseconds from the rising of "+5V" line.

Therefore every power lines voltage must be established within 500 milli-seconds at a power on stage.

- (2) Minimum 500 milli-seconds power-off-holding term must be taken between a power on/off cycle.

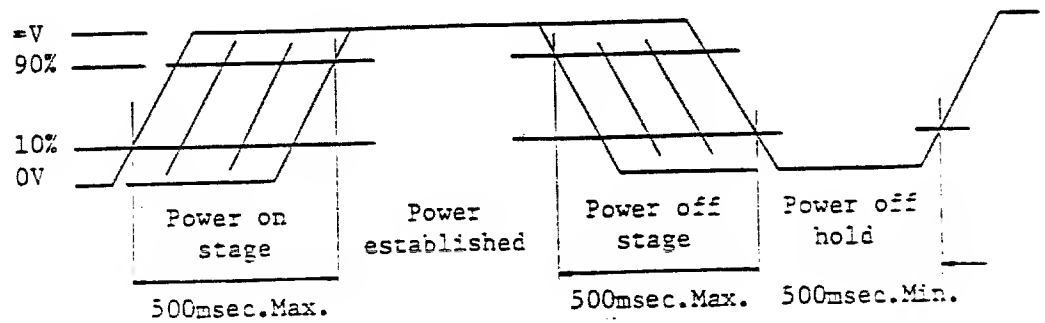


Figure 3-4 Power Sequence

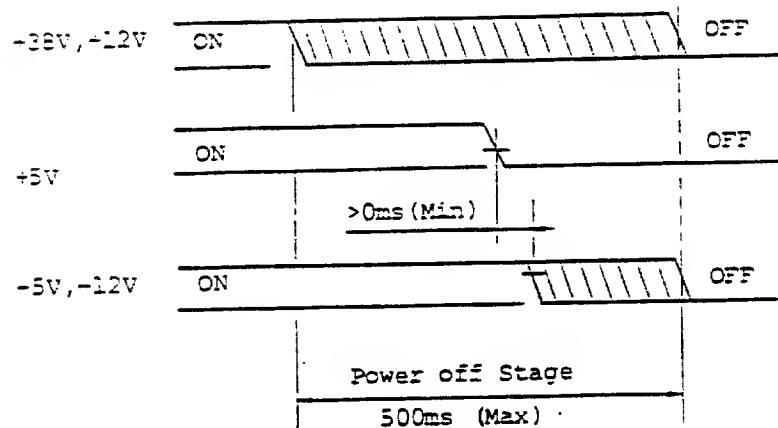


Figure 3-4(b) Detail of Power Off Sequence

### 3.4 AC-POWER REQUIREMENT (D2362 WITH POWER SUPPLY)

The D2362 Disk Drive with the 752/(747) Power Supply requires following input conditions:

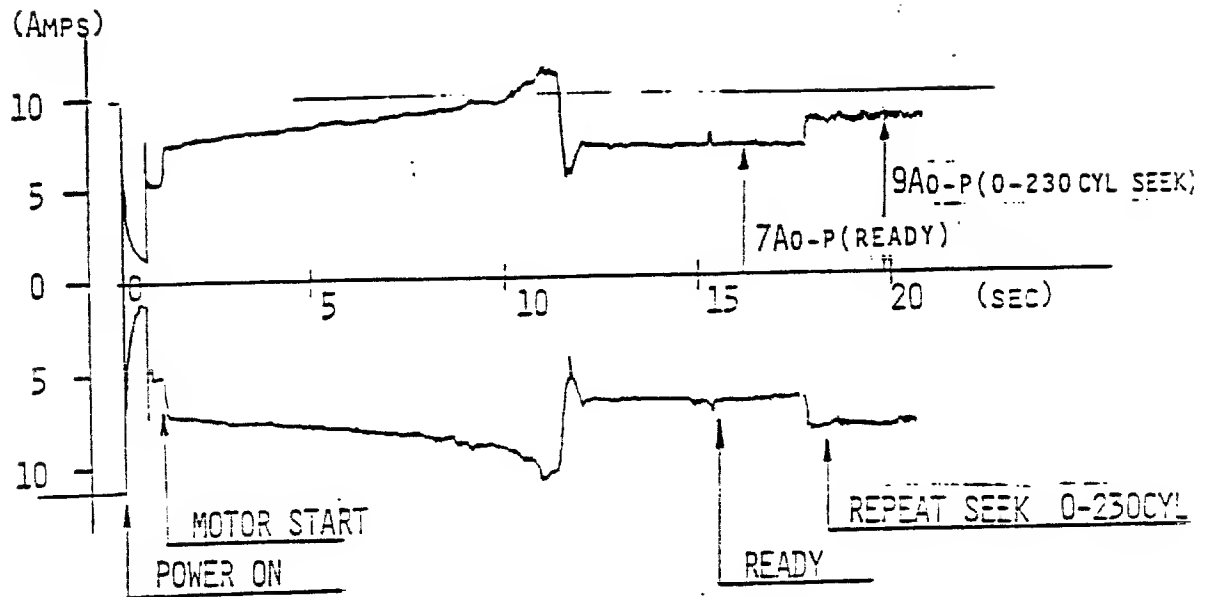
- (1) Input voltage : 100V - 120VAC/200V - 240VAC (Selectable)
- (2) Input frequency: 50/60Hz 2%
- (3) Phase : Single-phase with ground
- (4) Inlet :
- (5) Line current :

	<u>115VAC/60Hz</u>	<u>220VAC/50Hz</u>
Average	3.3A	2.0A
Start-up	4.5A	2.8A
Rush(~5 cycles)	10A <sub>0-peak</sub>	12A <sub>0-peak</sub>
Power factor	72%	62%
Power consumed		
Average	270W	260W
Start-up	370W	360W

Refer to the Appendix-E for the detail description of 752 Power Supply.

### 3.4.1 AC Input Requirement (Example)

#### AC CURRENT PROFILE



INPUT SOURCE: 115VAC

EFFECTIVE CURRENT & ACTIVE POWER (115VAC)

	STOPPED	START UP	READY	REPEAT SEEK
EFFECTIVE CURRENT	1.3A	4.7A	2.8A	3.5A
ACTIVE POWER	90W	380W	220W	280W

(WITHOUT OPTION)





## CHAPTER 4

### INSTALLATION

This chapter provides the recommended procedures to install the Disk Drive. It includes the environmental consideration, the packing and unpacking procedures, and the start/stop operations. Also included are the installation layout illustrations and appropriate dimensions.

#### 4.1 SITE PREPARATION

Site preparation procedures include the environmental specifications, the recommended air flow, the service space dimensions around the drive, and the power requirements. We recommend that you follow these procedures for satisfactory disk drive performance and longevity.

##### 4.1.1 Environmental Specifications

The permissible operating and nonoperating environmental specifications are listed in Table 2-1.

##### 4.1.2 Air Flow/Service Area

An air flow rate of more than 1.5 cubic meter per minute shall be maintained through the air flow path illustrated in Figure 4-1.

#### 4.2 UNPACKING/PACKING

Unpack the disk drive using the following procedure.  
(Refer to Figure 2-10)

NOTE: Failure to adhere to this procedure could result in voiding the warranty.

- a. Before you unpack the disk drive, inspect its container for damage. If you notice any damage, notify the carrier immediately. Do not open the container until the carrier's representative is present. If there is no damage to the container, continue with step b.
- b. Carefully open the container and save all packaging material for reshipping.
- c. Check all items against the shipping bill to ensure that none are missing or damaged.
- d. Inspect the disk drive for shipping damage.
- e. To repack the disk drive, reverse these steps.

### 4.3 INSTALLATION

This section provides the information to install the D2362 Disk Drive in a rack or cabinet.

#### 4.3.1 Installation Requirements

Refer to Figure 2-3 and 2-4 for mounting dimensions.

- (1) The drive shall be installed to meet the environmental and power conditions shown in Table 2-1.
- (2) The drive shall be installed horizontally to the rack or cabinet.
- (3) The air flow is illustrated in Figure 4-1 to assure the flow rate of more than  $1.5 \text{ m}^3/\text{min}$ .

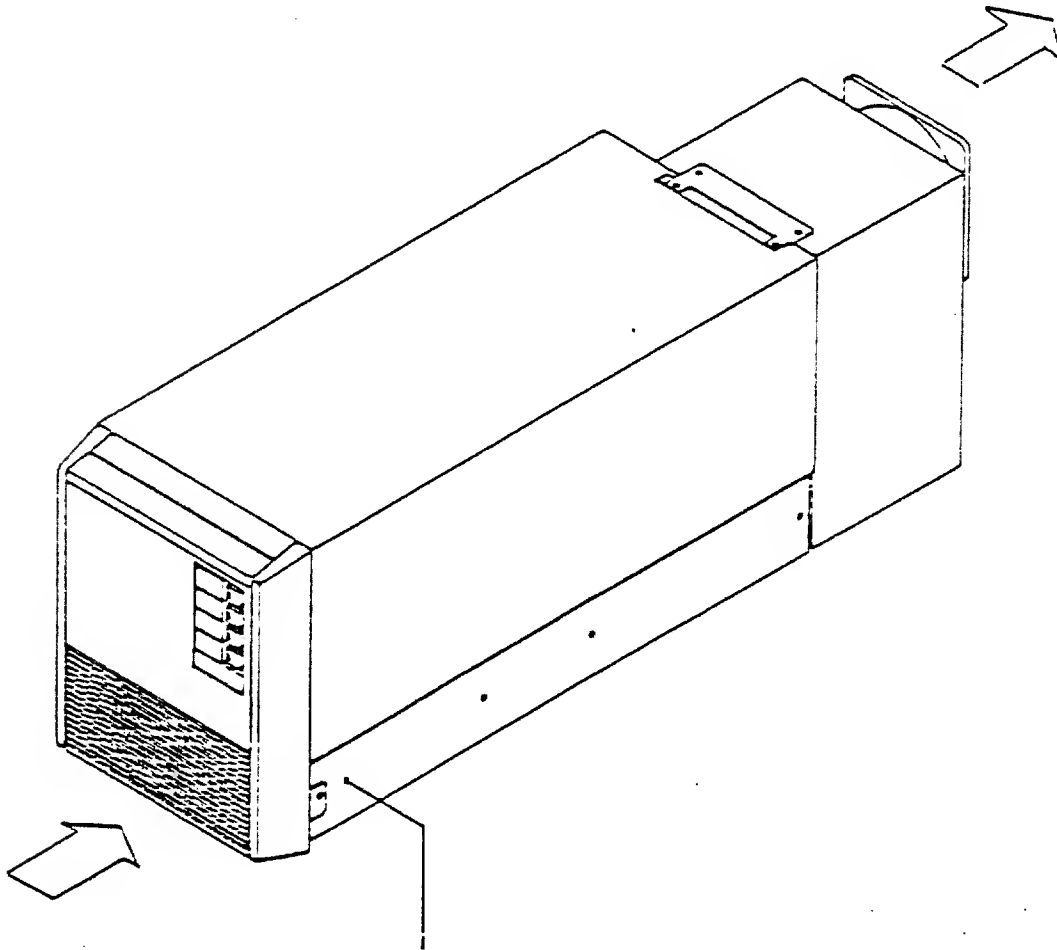


Figure 4-1 Air Flow

#### 4.3.2 Installation Requirements for Options & Accessories.

##### (1) For Power Supply Option

###### Power Supply Voltage Conversion

When the power supply is shipped, its input is set to operate in 100 - 120 V.

The power supply has voltage selector located on the side of a cooling fan to conform to each site power.

###### CAUTION

Voltage Selector should be necessarily changed to the desired input-range before an ac power cord is connected.

If this operation is neglected, the power supply will be broken.

###### Procedure of Voltage Conversion (Refer to Figure B-1)

(a) Release Voltage Selector Cover fixed with two screws.

(b) When adapting to the 100 - 120 V AC range, turn the selection switch to 100 - 120 V.

When adapting to the 200 - 240 V AC range, turn the selection switch to 200 - 240 V.

(c) Fix the Voltage Selector Cover with two screws.

(d) The set voltage range is indicated on or under the Voltage Selector.

(2) (TBD)

#### 4.3.3 Installation Layout

The Figures below are the installation examples of D2362. The drive will be installed in a standard 19-inch rack as illustrated in Figure 4-4 and special small rack as illustrated in Figure 4-5.

Installation details are shown in Figure 4-6, 4-7 and Figure 4-8.

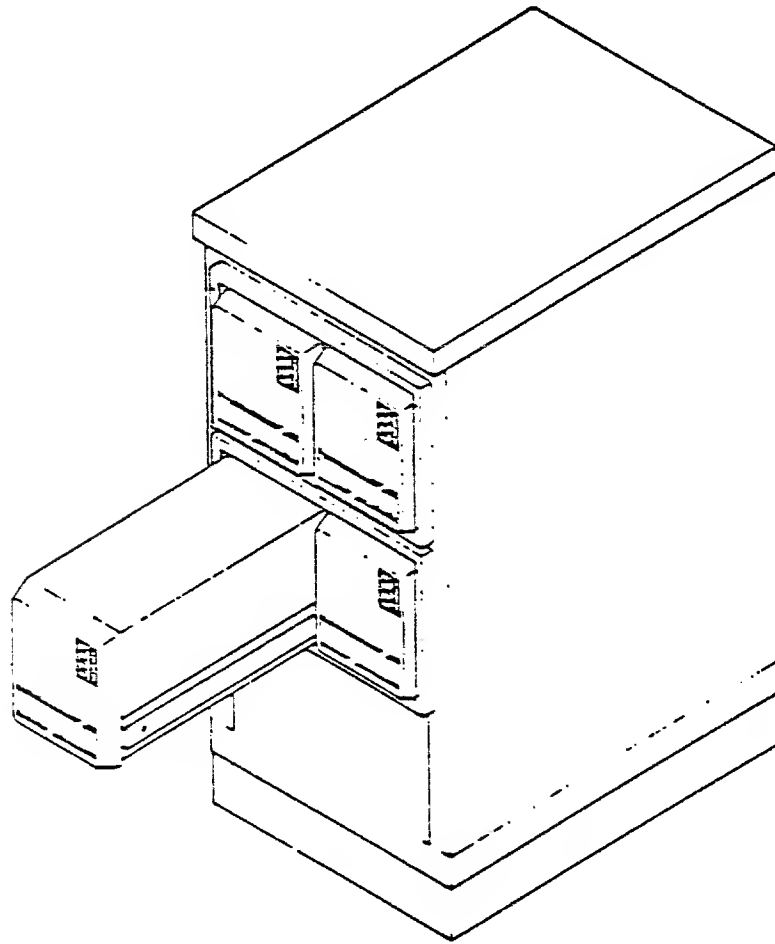


Figure 4-4 Installation in a standard 19 inch rack

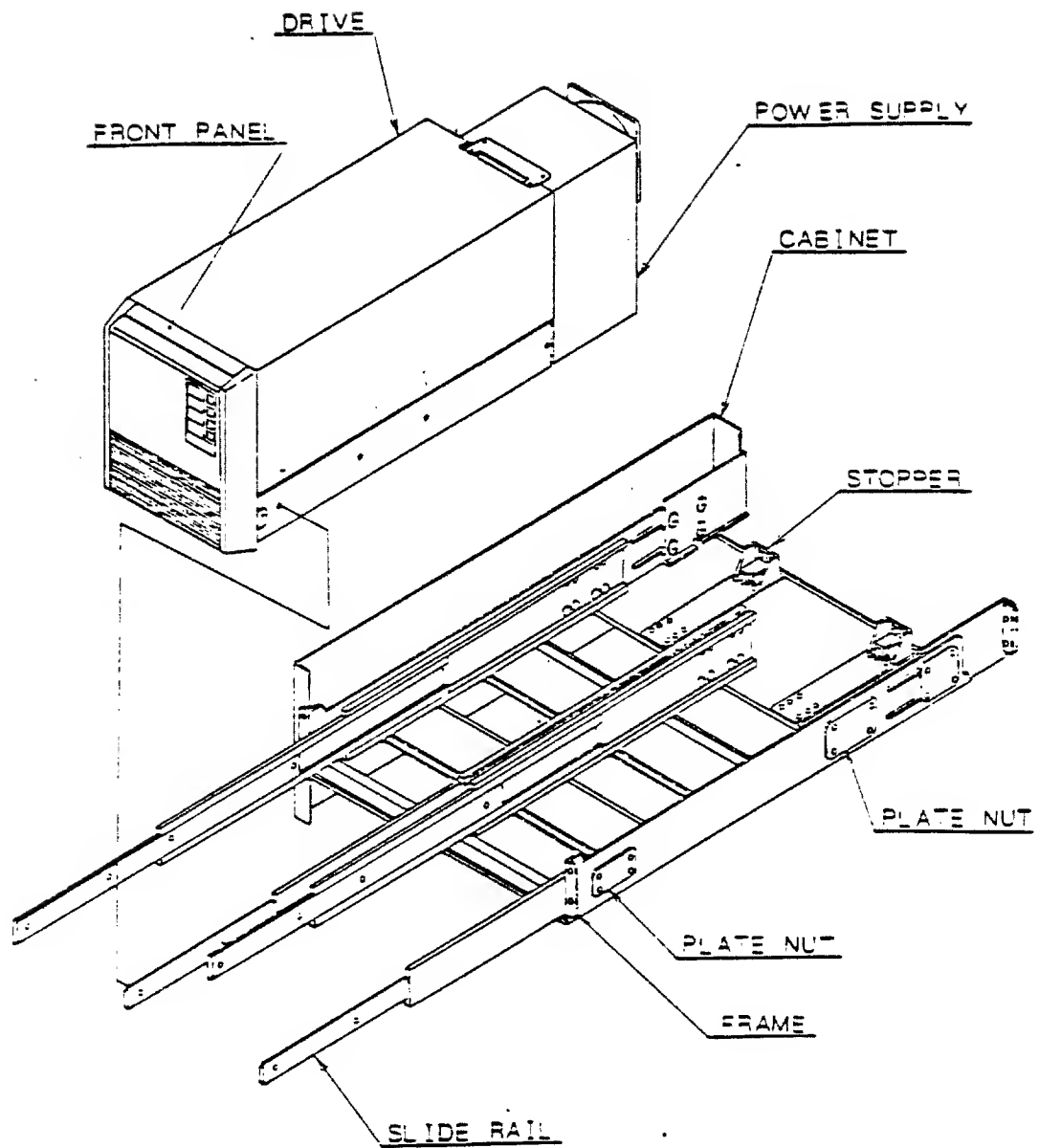


Figure 4-5 6U MOUNT KIT

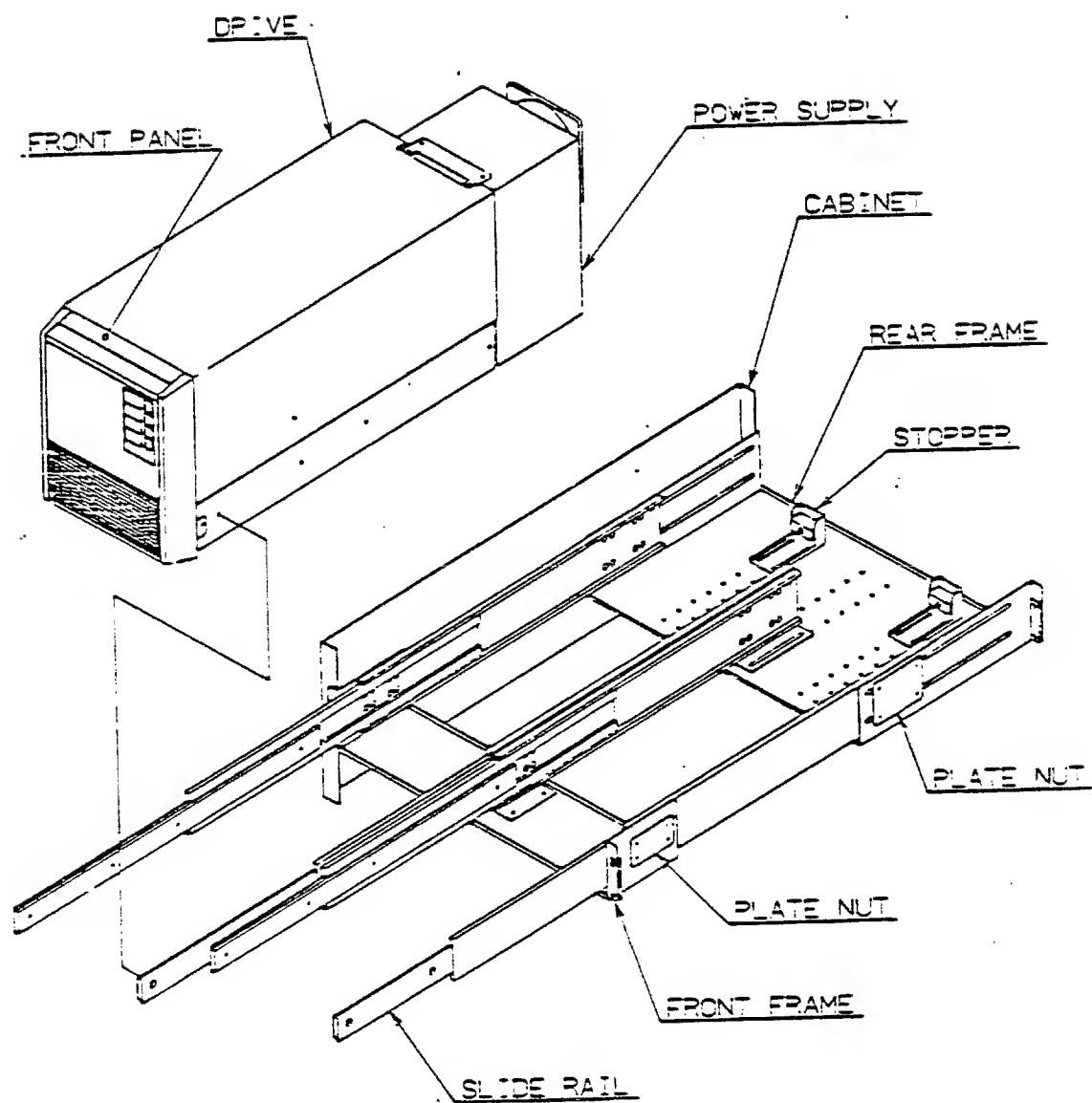


Figure 4-6 7U MOUNT KIT

#### 4.4 MODE AND FUNCTION SWITCH SETTINGS

The disk drive contains three dual-inline-packaged (DIP) switch assemblies for Selection of Installation Mode, Control Mode, and Sectoring number.

All these switches are equipped on the "LOGIC & SERVO" PWA, and the detail location of each DIP switch Assy is shown in Figure 4-7.



# LED AND SWITCHES ASSIGNMENT (BASIC)

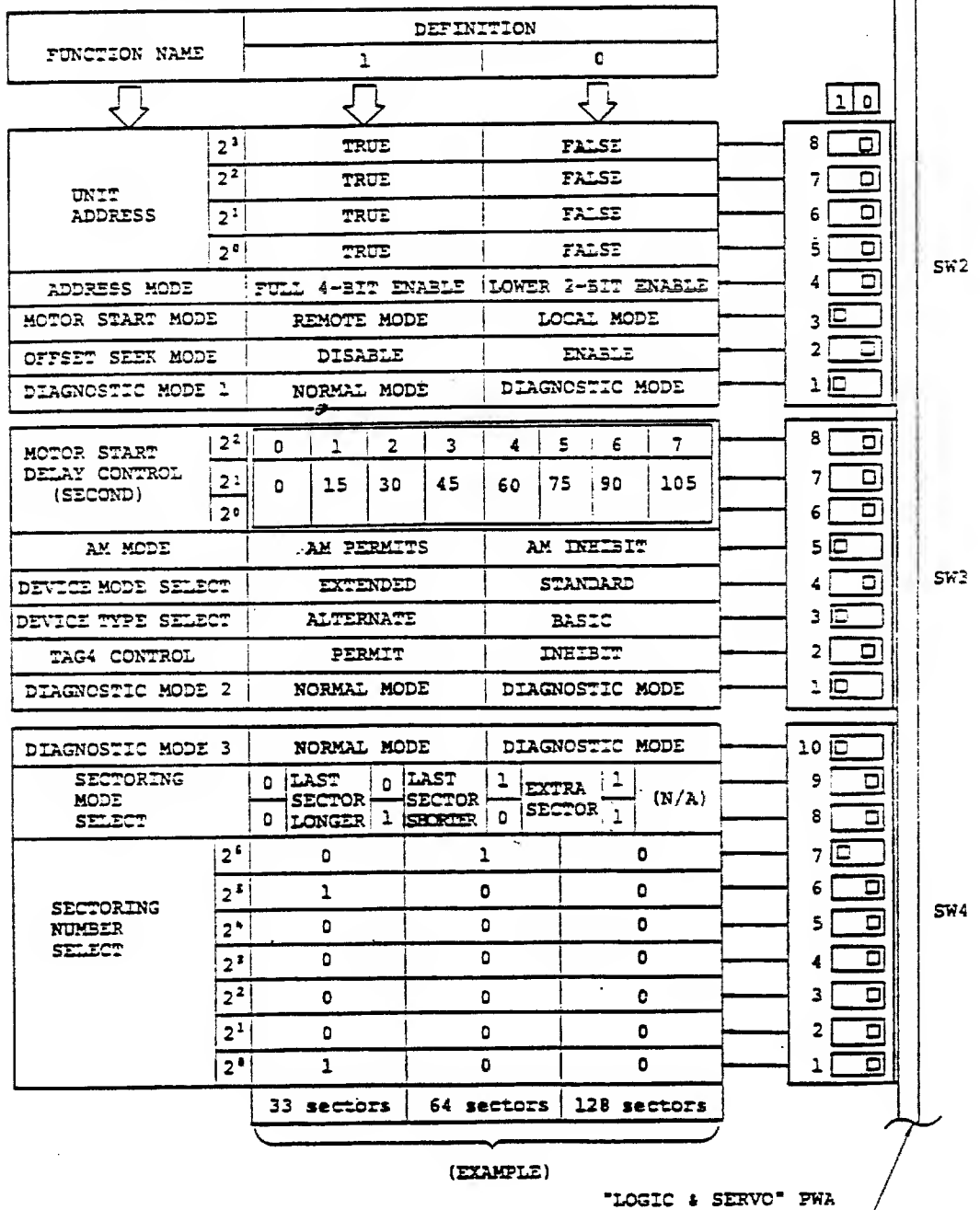


Figure 4-7 Parameters Selection DIP Switches

#### 4.4.1 Detail of "SW2" (Installation Mode DIP Switch)

- (1) The switch bit 8 through bit 5 is assigned as the Unit Address switches.

The Unit Address (or also called Device Number) switches are contained in the DIP switch located at "SW2" position on the SMD Logic PWA.

One of sixteen or four Address code (0, 1, 2, and 3, or through to 15) is selected by the "UNIT NO." switches consisting of four or two bits. Refer to the Figure 4-7 for preset of a desired unit address to the drive.

- (2) Address mode select switch

When this switch is set to "2 BIT ADDRESS MODE", the Unit Select bit 2<sup>0</sup> bit 2<sup>1</sup> of the SMD Interface line are used only for unit address compare. (Bit 2<sup>2</sup> and 2<sup>3</sup> are ignored.)

When this switch is set to "4 BIT ADDRESS MODE", the full Unit Select bit 2<sup>0</sup>, 2<sup>1</sup> and 2<sup>3</sup> are used for unit Address compare.

When the External Operator Panel function (including 752 Front Panel) is used, these switches should be preset to "FREE" (all 1).

- (3) Motor start mode switch

The disk drive is started in either "REMOTE" or "LOCAL" mode by the selection of the switch bit of "SW2" DIP sw.

- (a) LOCAL mode - enables DC power-on initiate the drive start up sequence.
- (b) REMOTE mode - normally set to REMOTE at shipping, the drive is started by receiving ground level of the Power Sequence Hold line from the host system.

- (4) Offset seek mode switch

The switch bit 2 of "SW2" DIP sw is assigned as a mode which enables the input of the "Offset Seek Operation".

When this bit is preset to disable, the drive would ignore the "Offset Seek Command".

- (5) Diagnostic mode 1

The switch bit 1 of "SW2" DIP sw is assigned for some diagnostics control in the factory. (Initial Seek Retry)

This bit must be preset to the "Normal Mode" while operations.

#### 4.4.2 Detail of "SW3" (Control Mode DIP Switch)

Figure 4-7 shows the details of the "SW3" 8-bit DIP switch Assy for the disk drive control mode setting.

##### (1) Motor start delay switches

The switch bit 8, bit 7 and bit 6 are assigned as Start Delay Setting switches. The spindle motor driving is delayed within the time specified by the Start Delay switches, even if the start-up conditions are satisfied. (DC power on and motor start mode satisfied) The setting of switches for selection of one of eight Delay Time (0, 15, 30, 45, 60, 75, 90 and 105 seconds) is shown in Figure 4-7.

This feature prevents the overload of the source power by the disk drives.

The start-up delay feature ensures that all the disk drives (upto two) in a multi-disk drive system configuration do not activate their power-up sequence operation simultaneously.

##### (2) AM-Mode Select switch

The switch bit 5 is used to enable or disable of the ADDRESS MARK Writing and ADDRESS MARK FOUND (Reading) functions.

The Device Type code is affected by this mode selection.  
(Refer to Table 4-1)

Table 4-1 D2362 Device Type Code

		Device Type Select—								"SW3"		
		DT7	DT6	DT5	DT4	DT3	DT2	DT1	DT0	"A"	"M"	"T"
AM DISABLE	(850 CYL)	1	1	0	1	1	0	1	0	0	0	1
AM ENABLE	(850 CYL)	1	1	1	1	1	0	1	0	1	0	1

(3) Device mode select

The switch bit 4 of "SW3" is assigned as a mode which enables the "Extended" Device feature which function is dependent on each model and/or customers requirement.

(4) Device type setting switches

The switch bit 3 is assigned as the Device Type Setting switch. This switch is used for preset the Encoded Device Type code. Table 4-1 shows the preset code for desired device type code which is sent back to the controller when the Device Type Request command issued.

(5) Tag 4 control

The switch bit 2 of "SW3" DIP sw is assigned as a gate which enables or disables the input of the "Tag 4 Operation".

(6) Diagnostic mode 2

The switch bit 1 of "SW3" DIP sw is assigned for some diagnostics control in the factory. (Fault Hold)

This bit must be preset to the "Normal Mode" while operation.

#### 4.4.3 Detail of "SW4"

(1) Diagnostic mode 3

The switch bit 10 of "SW4" DIP sw is assigned for some diagnostics control in the factory. (Fault Inhibit)

This bit must be preset to the "Normal Mode" while operations.

(2) The Sector Select Switches are shown in Figure 4-7. The Sector Select Switches consist of 9 independent switches (9-1 bit of "SW4"). The switch bit 9-8 of the DIP sw are assigned as "Format Setting Switches", and other switches (7-1 bit of the DIP sw) are assigned as "Sector Select Switches".

Selectable number of sectors per track is from one (sector equals track length) to 128 (divided to 128 blocks).

The "Sector Select Switches" shall be set by the simply same binary value which is requested as the number of sectors by the System-Controller.

The "Format Setting Switches" produce three methods of dividing track. The detail of their theory is following.

Basically, the length of one sector is obtained by following equation.

$$X = 2 \times \left\{ \text{Integral part of } \left( \frac{40,960}{2N} \right) \right\}$$

$$R = 40,960 - NX$$

X : Length of one sector (byte)  
 R : Remainder (byte)  
 N : Number of desired sectors  
 40,960: length of one track (byte)

When "R" does not equal "0", one can choose one of the following three methods to divide a track into the desired number of sectors. When "R" does equal "0", all three methods will produce the same result (all sectors equal "X").

(a) Last sector longer mode

All sectors except the last one have the same length "X", and last sector has a longer length of "X+R". The detail of length of sector is shown in Table 4-2.

(b) Last sector shorter mode

All sectors except the last one have the same length of "X + 2" and the last sector has a shorter length of "40,960 - n x (X + 2)", (see Table 4-3)

(c) Extra sector mode

In this mode, one track is divided into "N+1" sectors; sectors from 1 to N have the length of "X", and the (N+1)th sector has the length of "R". The detail of length of sectors is shown in Table 4-4.

The switch setting of "Format Select Switches" to select one of the above three methods is following.

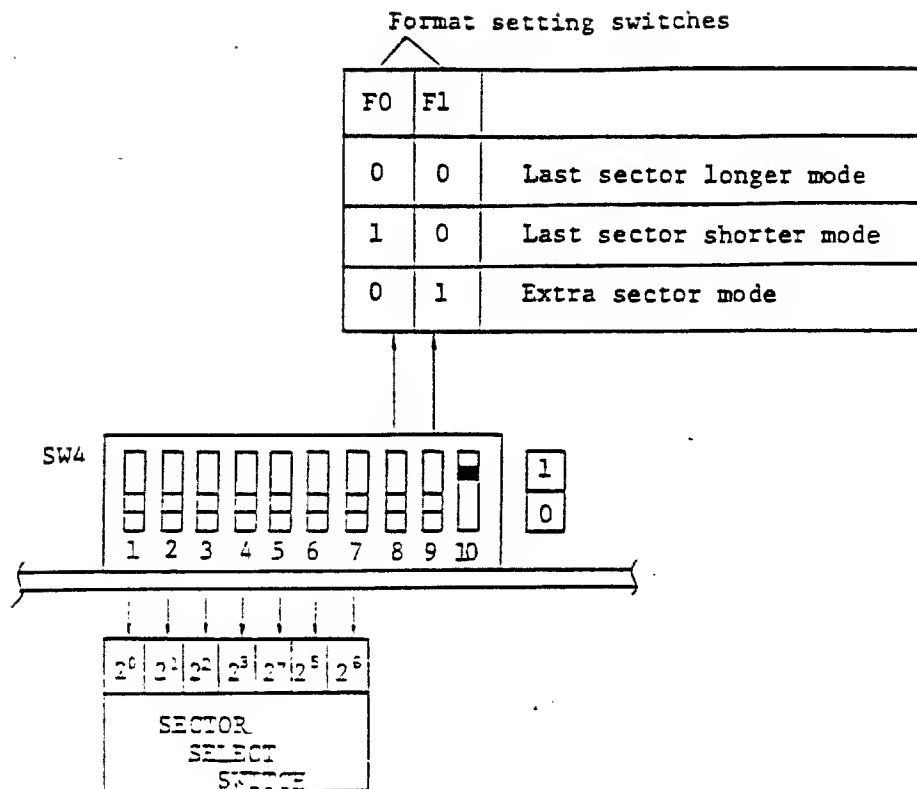


Figure 4-8 "SW4" Bit Assignment

Example; (1) Last sector longer mode

$N=33$  (Sectors/Track)

$$\left( \frac{40,960}{2 \times 33} \right) = 620.6$$

$X=2 \times 620=1,240$  (Bytes/Sector)

Last Sector= $1,240+(40,960-1,240 \times 33)=1,280$

A last sector of each track has the long bytes as shown in Table 4-2.

Example; (2) Last sector shorter mode

N=33 (Sectors/Track)

$$\left(\frac{40,960}{2 \times 33}\right) = 620.6$$

X=2x(620+1)=1,242 (Bytes/Sectors)

Last Sector=40,960-1,242x(33-1)=1,216

A last sector of each track has the short bytes as shown in the Table 4-3.

Example; (3) Extra sector mode

N=33 (Sectors/Track)

$$\left(\frac{40,960}{2 \times 33}\right) = 620.6$$

X=2x620=1,240 (Bytes/Sector)

Extra Sector Bytes=40,960-1,240x33=40

The extra sector of each track has the extra bytes as shown in the Table 4-4.

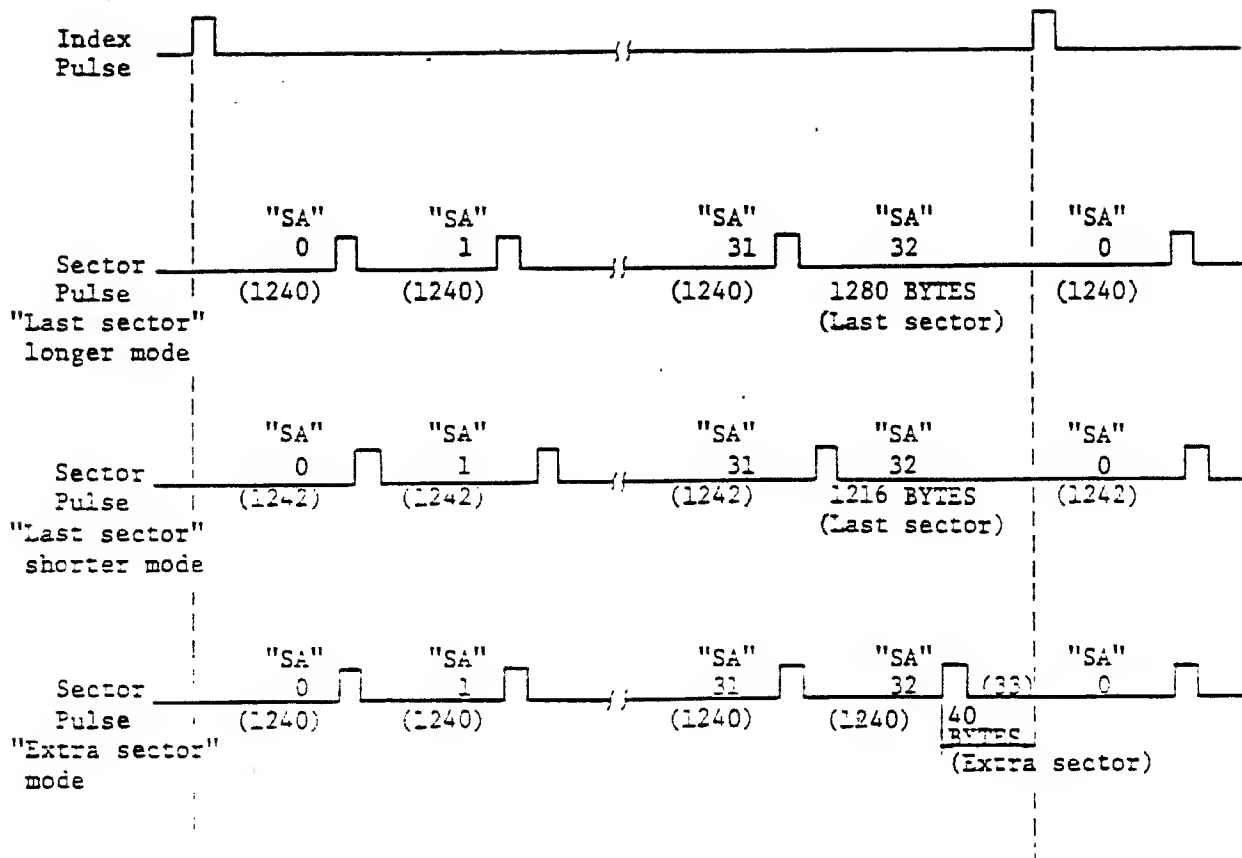


Figure 4-9 Sectoring Format Example



Table 4-2 Sector Selection List (1/4)  
"LAST SECTOR LONGER MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR LONGER MODE
F1F02625242322120			
0 0 0 0 0 0 0 0 1	1	40960	+0
0 0 0 0 0 0 0 0 1 0	2	20480	+0
0 0 0 0 0 0 0 0 1 1	3	13652	+4
0 0 0 0 0 0 0 1 0 0	4	10240	+0
0 0 0 0 0 0 0 1 0 1	5	8192	+0
0 0 0 0 0 0 0 1 1 0	6	6826	+4
0 0 0 0 0 0 0 1 1 1	7	5850	+10
0 0 0 0 0 1 0 0 0 0	8	5120	+0
0 0 0 0 0 1 0 0 0 1	9	4550	+10
0 0 0 0 0 1 0 1 0 0	10	4096	+0
0 0 0 0 0 1 0 1 1 1	11	3722	+18
0 0 0 0 0 1 1 0 0 0	12	3412	+16
0 0 0 0 0 1 1 0 0 1	13	3150	+10
0 0 0 0 0 1 1 1 0 0	14	2924	+24
0 0 0 0 0 1 1 1 1 1	15	2730	+10
0 0 0 0 1 0 0 0 0 0	16	2560	+0
0 0 0 0 1 0 0 0 0 1	17	2408	+24
0 0 0 0 1 0 0 0 1 0	18	2274	+28
0 0 0 0 1 0 0 1 1 1	19	2154	+34
0 0 0 0 1 0 1 0 0 0	20	2048	+0
0 0 0 0 1 0 1 0 1 1	21	1950	+10
0 0 0 0 1 0 1 1 0 0	22	1860	+40
0 0 0 0 1 0 1 1 1 1	23	1780	+20
0 0 0 0 1 1 0 0 0 0	24	1706	+16
0 0 0 0 1 1 0 0 0 1	25	1638	+10
0 0 0 0 1 1 0 1 0 0	26	1574	+36
0 0 0 0 1 1 0 1 1 1	27	1516	+28
0 0 0 0 1 1 1 0 0 0	28	1462	+24
0 0 0 0 1 1 1 0 1 1	29	1412	+12
0 0 0 0 1 1 1 1 0 0	30	1364	+40
0 0 0 0 1 1 1 1 1 1	31	1320	+40
0 0 0 1 0 0 0 0 0 0	32	1280	+0
0 0 0 1 0 0 0 0 0 1	33	1240	+40
0 0 0 1 0 0 0 0 1 0	34	1204	+24
0 0 0 1 0 0 0 0 1 1	35	1170	+10
0 0 0 1 0 0 1 0 0 0	36	1136	+64
0 0 0 1 0 0 1 0 0 1	37	1106	+38
0 0 0 1 0 0 1 1 0 0	38	1076	+72
0 0 0 1 0 0 1 1 1 1	39	1050	+10
0 0 0 1 0 1 0 0 0 0	40	1024	+0

Table 4-2 Sector Selection List (2/4)  
"LAST SECTOR LONGER MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR LONGER MODE
F1F026252423222120			
0 0 0 1 0 1 0 0 1	41	998	+42
0 0 0 1 0 1 0 1 0	42	974	+52
0 0 0 1 0 1 0 1 1	43	952	+24
0 0 0 1 0 1 1 0 0	44	930	+40
0 0 0 1 0 1 1 0 1	45	910	+10
0 0 0 1 0 1 1 1 0	46	890	+20
0 0 0 1 0 1 1 1 1	47	870	+70
0 0 0 1 1 0 0 0 0	48	852	+64
0 0 0 1 1 0 0 0 1	49	834	+94
0 0 0 1 1 0 0 1 0	50	818	+60
0 0 0 1 1 0 0 1 1	51	802	+58
0 0 0 1 1 0 1 0 0	52	786	+86
0 0 0 1 1 0 1 0 1	53	772	+44
0 0 0 1 1 0 1 1 0	54	758	+28
0 0 0 1 1 0 1 1 1	55	744	+40
0 0 0 1 1 1 0 0 0	56	730	+80
0 0 0 1 1 1 0 0 1	57	718	-34
0 0 0 1 1 1 0 1 0	58	706	+12
0 0 0 1 1 1 0 1 1	59	694	+14
0 0 0 1 1 1 1 0 0	60	682	+40
0 0 0 1 1 1 1 0 1	61	670	+90
0 0 0 1 1 1 1 1 0	62	660	-40
0 0 0 1 1 1 1 1 1	63	650	+10
0 0 1 0 0 0 0 0 0	64	640	+0
0 0 1 0 0 0 0 0 1	65	630	+10
0 0 1 0 0 0 0 1 0	66	620	+40
0 0 1 0 0 0 0 1 1	67	610	+90
0 0 1 0 0 0 1 0 0	68	602	+24
0 0 1 0 0 0 1 0 1	69	592	+112
0 0 1 0 0 0 1 1 0	70	584	+80
0 0 1 0 0 0 1 1 1	71	576	+64
0 0 1 0 0 1 0 0 0	72	568	+64
0 0 1 0 0 1 0 0 1	73	560	+80
0 0 1 0 0 1 0 1 0	74	552	+112
0 0 1 0 0 1 0 1 1	75	546	+10
0 0 1 0 0 1 1 0 0	76	538	+72
0 0 1 0 0 1 1 0 1	77	530	+150
0 0 1 0 0 1 1 1 0	78	524	+88
0 0 1 0 0 1 1 1 1	79	518	+38
0 0 1 0 1 0 0 0 0	80	512	+0

Table 4-2 Sector Selection List (3/4)  
"LAST SECTOR LONGER MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR LONGER MODE
F1F026252423222120			
0 0 1 0 1 0 0 0 1	81	504	+136
0 0 1 0 1 0 0 1 0	82	498	+124
0 0 1 0 1 0 0 1 1	83	492	+124
0 0 1 0 1 0 1 0 0	84	486	+136
0 0 1 0 1 0 1 0 1	85	480	+160
0 0 1 0 1 0 1 1 0	86	476	+24
0 0 1 0 1 0 1 1 1	87	470	+70
0 0 1 0 1 1 0 0 0	88	464	+128
0 0 1 0 1 1 0 0 1	89	460	+20
0 0 1 0 1 1 0 1 0	90	454	+100
0 0 1 0 1 1 0 1 1	91	450	+10
0 0 1 0 1 1 1 0 0	92	444	+112
0 0 1 0 1 1 1 0 1	93	440	+40
0 0 1 0 1 1 1 1 0	94	434	+164
0 0 1 0 1 1 1 1 1	95	430	+110
0 0 1 1 0 0 0 0 0	96	426	+64
0 0 1 1 0 0 0 0 1	97	422	+26
0 0 1 1 0 0 0 1 0	98	416	+192
0 0 1 1 0 0 0 1 1	99	412	+172
0 0 1 1 0 0 1 0 0	100	408	+160
0 0 1 1 0 0 1 0 1	101	404	+156
0 0 1 1 0 0 1 1 0	102	400	+160
0 0 1 1 0 0 1 1 1	103	396	+172
0 0 1 1 0 1 0 0 0	104	392	+192
0 0 1 1 0 1 0 0 1	105	390	+10
0 0 1 1 0 1 0 1 0	106	386	+44
0 0 1 1 0 1 0 1 1	107	382	+86
0 0 1 1 0 1 1 0 0	108	378	+136
0 0 1 1 0 1 1 0 1	109	374	+194
0 0 1 1 0 1 1 1 0	110	372	+40
0 0 1 1 0 1 1 1 1	111	368	+112
0 0 1 1 1 0 0 0 0	112	364	+192
0 0 1 1 1 0 0 0 1	113	362	+54
0 0 1 1 1 0 0 1 0	114	358	+148
0 0 1 1 1 0 0 1 1	115	358	+20
0 0 1 1 1 0 1 0 0	116	352	+128
0 0 1 1 1 0 1 0 1	117	350	+10
0 0 1 1 1 0 1 1 0	118	346	+132
0 0 1 1 1 0 1 1 1	119	344	+24
0 0 1 1 1 1 0 0 0	120	340	+160

Table 4-2 Sector Selection List (4/4)  
 "LAST SECTOR LONGER MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR LONGER MODE
$F_1 F_0 2^6 2^5 2^4 2^3 2^2 2^1 2^0$			
0 0 1 1 1 1 0 0 1	121	338	+62
0 0 1 1 1 1 0 1 0	122	334	+212
0 0 1 1 1 1 0 1 1	123	332	+124
0 0 1 1 1 1 1 0 0	124	330	+40
0 0 1 1 1 1 1 0 1	125	326	+210
0 0 1 1 1 1 1 1 0	126	324	+136
0 0 1 1 1 1 1 1 1	127	322	+66
0 0 0 0 0 0 0 0 0	128	320	+0

Table 4-3 Sector Selection List (1/4)  
"LAST SECTOR SHORTER MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR SHORTER
F1F026252423222120			
0 1 0 0 0 0 0 0 1	1	40960	0
0 1 0 0 0 0 0 0 1 0	2	20480	0
0 1 0 0 0 0 0 0 1 1	3	13654	-2
0 1 0 0 0 0 0 1 0 0	4	10240	0
0 1 0 0 0 0 0 1 0 1	5	8192	0
0 1 0 0 0 0 0 1 1 0	6	6828	-8
0 1 0 0 0 0 0 1 1 1	7	5852	-4
0 1 0 0 0 0 1 0 0 0	8	5120	0
0 1 0 0 0 0 1 0 0 1	9	4552	-8
0 1 0 0 0 0 1 0 1 0	10	4096	0
0 1 0 0 0 0 1 0 1 1	11	3724	-4
0 1 0 0 0 0 1 1 0 0	12	3414	-8
0 1 0 0 0 0 1 1 0 1	13	3152	-16
0 1 0 0 0 0 1 1 1 0	14	2926	-4
0 1 0 0 0 0 1 1 1 1	15	2732	-20
0 1 0 0 0 1 0 0 0 0	16	2560	0
0 1 0 0 0 1 0 0 0 1	17	2410	-10
0 1 0 0 0 1 0 0 1 0	18	2276	-8
0 1 0 0 0 1 0 0 1 1	19	2156	-4
0 1 0 0 0 1 0 1 0 0	20	2048	0
0 1 0 0 0 1 0 1 0 1	21	1952	-32
0 1 0 0 0 1 0 1 1 0	22	1862	-4
0 1 0 0 0 1 0 1 1 1	23	1782	-26
0 1 0 0 0 1 1 0 0 0	24	1708	-32
0 1 0 0 0 1 1 0 0 1	25	1640	-40
0 1 0 0 0 1 1 0 1 0	26	1576	-16
0 1 0 0 0 1 1 0 1 1	27	1518	-26
0 1 0 0 0 1 1 1 0 0	28	1464	-32
0 1 0 0 0 1 1 1 0 1	29	1414	-46
0 1 0 0 0 1 1 1 1 0	30	1366	-20
0 1 0 0 0 1 1 1 1 1	31	1322	-22
0 1 0 1 0 0 0 0 0 0	32	1280	0
0 1 0 1 0 0 0 0 0 1	33	1242	-26
0 1 0 1 0 0 0 0 1 0	34	1206	-44
0 1 0 1 0 0 0 0 1 1	35	1172	-60
0 1 0 1 0 0 0 1 0 0	36	1138	-8
0 1 0 1 0 0 0 1 0 1	37	1108	-36
0 1 0 1 0 0 0 1 1 0	38	1078	-4
0 1 0 1 0 0 0 1 1 1	39	1052	-68
0 1 0 1 0 0 1 0 0 0	40	1024	0

Table 4-3 Sector Selection List (2/4)  
"LAST SECTOR SHORTER MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR SHORTER
F1F02625242322120			
0 1 0 1 0 1 0 0 1	41	1000	-40
0 1 0 1 0 1 0 1 0	42	976	-32
0 1 0 1 0 1 0 1 1	43	954	-62
0 1 0 1 0 1 1 0 0	44	932	-48
0 1 0 1 0 1 1 0 1	45	912	-80
0 1 0 1 0 1 1 1 0	46	892	-72
0 1 0 1 0 1 1 1 1	47	872	-24
0 1 0 1 1 0 0 0 0	48	854	-32
0 1 0 1 1 0 0 0 1	49	836	-4
0 1 0 1 1 0 0 1 0	50	820	-40
0 1 0 1 1 0 0 1 1	51	804	-44
0 1 0 1 1 0 1 0 0	52	788	-16
0 1 0 1 1 0 1 0 1	53	774	-62
0 1 0 1 1 0 1 1 0	54	760	-80
0 1 0 1 1 0 1 1 1	55	746	-70
0 1 0 1 1 1 0 0 0	56	732	-32
0 1 0 1 1 1 0 0 1	57	720	-80
0 1 0 1 1 1 0 1 0	58	708	-104
0 1 0 1 1 1 0 1 1	59	696	-104
0 1 0 1 1 1 1 0 0	60	684	-80
0 1 0 1 1 1 1 0 1	61	672	-32
0 1 0 1 1 1 1 1 0	62	662	-54
0 1 0 1 1 1 1 1 1	63	652	-116
0 1 1 0 0 0 0 0 0	64	640	0
0 1 1 0 0 0 0 0 1	65	632	-120
0 1 1 0 0 0 0 1 0	66	622	-92
0 1 1 0 0 0 0 1 1	67	612	-44
0 1 1 0 0 0 1 0 0	68	604	-112
0 1 1 0 0 0 1 0 1	69	594	-26
0 1 1 0 0 0 1 1 0	70	586	-60
0 1 1 0 0 0 1 1 1	71	578	-78
0 1 1 0 0 1 0 0 0	72	570	-80
0 1 1 0 0 1 0 0 1	73	562	-66
0 1 1 0 0 1 0 1 0	74	554	-36
0 1 1 0 0 1 0 1 1	75	548	-140
0 1 1 0 0 1 1 0 0	76	540	-80
0 1 1 0 0 1 1 0 1	77	532	-4
0 1 1 0 0 1 1 1 0	78	526	-68
0 1 1 0 0 1 1 1 1	79	520	-120
0 1 1 0 1 0 0 0 0	80	512	0

Table 4-3 Sector Selection List (3/4)  
"LAST SECTOR SHORTER MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR SHORTER
F <sup>1</sup> C <sup>2</sup> 5 <sup>3</sup> 4 <sup>2</sup> 3 <sup>2</sup> 2 <sup>1</sup> 0 <sup>0</sup>			
0 1 1 0 1 0 0 0 1	81	506	-26
0 1 1 0 1 0 0 1 0	82	500	-40
0 1 1 0 1 0 0 1 1	83	494	-42
0 1 1 0 1 0 1 0 0	84	488	-32
0 1 1 0 1 0 1 0 1	85	482	-10
0 1 1 0 1 0 1 1 0	86	478	-148
0 1 1 0 1 0 1 1 1	87	472	-104
0 1 1 0 1 1 0 0 0	88	466	-48
0 1 1 0 1 1 0 0 1	89	462	-158
0 1 1 0 1 1 0 1 0	90	456	-80
0 1 1 0 1 1 0 1 1	91	452	-172
0 1 1 0 1 1 1 0 0	92	446	-72
0 1 1 0 1 1 1 0 1	93	442	-146
0 1 1 0 1 1 1 1 0	94	436	-24
0 1 1 0 1 1 1 1 1	95	432	-80
0 1 1 1 0 0 0 0 0	96	428	-128
0 1 1 1 0 0 0 0 1	97	424	-168
0 1 1 1 0 0 0 1 0	98	418	-4
0 1 1 1 0 0 0 1 1	99	414	-26
0 1 1 1 0 0 1 0 0	100	410	-40
0 1 1 1 0 0 1 0 1	101	406	-46
0 1 1 1 0 0 1 1 0	102	402	-44
0 1 1 1 0 0 1 1 1	103	398	-34
0 1 1 1 0 1 0 0 0	104	394	-16
0 1 1 1 0 1 0 0 1	105	392	-200
0 1 1 1 0 1 0 1 0	106	388	-168
0 1 1 1 0 1 0 1 1	107	384	-128
0 1 1 1 0 1 1 0 0	108	380	-80
0 1 1 1 0 1 1 0 1	109	376	-24
0 1 1 1 0 1 1 1 0	110	374	-180
0 1 1 1 0 1 1 1 1	111	370	-110
0 1 1 1 1 0 0 0 0	112	366	-32
0 1 1 1 1 0 0 0 1	113	364	-172
0 1 1 1 1 0 0 1 0	114	360	-80
0 1 1 1 1 0 0 1 1	115	358	-210
0 1 1 1 1 0 1 0 0	116	354	-104
0 1 1 1 1 0 1 0 1	117	352	-224
0 1 1 1 1 0 1 1 0	118	348	-104
0 1 1 1 1 0 1 1 1	119	346	-214
0 1 1 1 1 1 0 0 0	120	342	-80

Table 4-3 Sector Selection List (4/4)  
 "LAST SECTOR SHORTER MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	LAST SECTOR SHORTER
F1 F0 2 6 2 5 2 4 2 3 2 2 1 2 0			
0 1 1 1 1 1 0 0 1	121	340	-180
0 1 1 1 1 1 0 1 0	122	336	-32
0 1 1 1 1 1 0 1 1	123	334	-122
0 1 1 1 1 1 1 0 0	124	332	-208
0 1 1 1 1 1 1 0 1	125	328	-40
0 1 1 1 1 1 1 1 0	126	326	-116
0 1 1 1 1 1 1 1 1	127	324	-118
0 1 0 0 0 0 0 0 0	128	320	0



Table 4-4 Sector Selection List (1/4)  
"EXCESS SECTOR MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	EXCESS SECTOR BYTES
F <sup>1</sup> F <sup>0</sup> 2 <sup>6</sup> 2 <sup>5</sup> 2 <sup>4</sup> 2 <sup>3</sup> 2 <sup>2</sup> 2 <sup>1</sup> 2 <sup>0</sup>			
1 0 0 0 0 0 0 0 1	1	40960	0
1 0 0 0 0 0 0 0 1 0	2	20480	0
1 0 0 0 0 0 0 0 1 1	3	13652	4
1 0 0 0 0 0 0 1 0 0	4	10240	0
1 0 0 0 0 0 0 1 0 1	5	8192	0
1 0 0 0 0 0 0 1 1 0	6	6826	4
1 0 0 0 0 0 0 1 1 1	7	5850	10
1 0 0 0 0 1 0 0 0	8	5120	0
1 0 0 0 0 1 0 0 1	9	4550	10
1 0 0 0 0 1 0 1 0	10	4096	0
1 0 0 0 0 1 0 1 1	11	3722	18
1 0 0 0 0 1 1 0 0	12	3412	16
1 0 0 0 0 1 1 0 1	13	3150	10
1 0 0 0 0 1 1 1 0	14	2924	24
1 0 0 0 0 1 1 1 1	15	2730	10
1 0 0 0 1 0 0 0 0	16	2560	0
1 0 0 0 1 0 0 0 1	17	2408	24
1 0 0 0 1 0 0 1 0	18	2274	28
1 0 0 0 1 0 0 1 1	19	2154	34
1 0 0 0 1 0 1 0 0	20	2048	0
1 0 0 0 1 0 1 0 1	21	1950	10
1 0 0 0 1 0 1 1 0	22	1860	40
1 0 0 0 1 0 1 1 1	23	1780	20
1 0 0 0 1 1 0 0 0	24	1706	16
1 0 0 0 1 1 0 0 1	25	1638	10
1 0 0 0 1 1 0 1 0	26	1574	36
1 0 0 0 1 1 0 1 1	27	1516	28
1 0 0 0 1 1 1 0 0	28	1462	24
1 0 0 0 1 1 1 0 1	29	1412	12
1 0 0 0 1 1 1 1 0	30	1364	40
1 0 0 0 1 1 1 1 1	31	1320	40
1 0 0 1 0 0 0 0 0	32	1280	0
1 0 0 1 0 0 0 0 1	33	1240	40
1 0 0 1 0 0 0 1 0	34	1204	24
1 0 0 1 0 0 0 1 1	35	1170	10
1 0 0 1 0 0 1 0 0	36	1136	64
1 0 0 1 0 0 1 0 1	37	1106	38
1 0 0 1 0 0 1 1 0	38	1076	72
1 0 0 1 0 0 1 1 1	39	1050	10
1 0 0 1 0 1 0 0 0	40	1024	0

Table 4-4 Sector Selection List (2/4)  
"EXCESS SECTOR MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	EXCESS SECTOR BYTES
F1F026252423222120			
1 0 0 1 0 1 0 0 1	41	998	42
1 0 0 1 0 1 0 1 0	42	974	52
1 0 0 1 0 1 0 1 1	43	952	24
1 0 0 1 0 1 1 0 0	44	930	40
1 0 0 1 0 1 1 0 1	45	910	10
1 0 0 1 0 1 1 1 0	46	890	20
1 0 0 1 0 1 1 1 1	47	870	70
1 0 0 1 1 0 0 0 0	48	852	64
1 0 0 1 1 0 0 0 1	49	834	94
1 0 0 1 1 0 0 1 0	50	818	60
1 0 0 1 1 0 0 1 1	51	802	58
1 0 0 1 1 0 1 0 0	52	786	88
1 0 0 1 1 0 1 0 1	53	772	44
1 0 0 1 1 0 1 1 0	54	758	28
1 0 0 1 1 0 1 1 1	55	744	40
1 0 0 1 1 1 0 0 0	56	730	80
1 0 0 1 1 1 0 0 1	57	718	34
1 0 0 1 1 1 0 1 0	58	706	12
1 0 0 1 1 1 0 1 1	59	694	14
1 0 0 1 1 1 1 0 0	60	682	40
1 0 0 1 1 1 1 0 1	61	670	90
1 0 0 1 1 1 1 1 0	62	660	40
1 0 0 1 1 1 1 1 1	63	650	10
1 0 1 0 0 0 0 0 0	64	640	0
1 0 1 0 0 0 0 0 1	65	630	10
1 0 1 0 0 0 0 1 0	66	620	40
1 0 1 0 0 0 0 1 1	67	610	90
1 0 1 0 0 0 1 0 0	68	602	24
1 0 1 0 0 0 1 0 1	69	592	112
1 0 1 0 0 0 1 1 0	70	584	80
1 0 1 0 0 0 1 1 1	71	576	64
1 0 1 0 0 1 0 0 0	72	568	64
1 0 1 0 0 1 0 0 1	73	560	80
1 0 1 0 0 1 0 1 0	74	552	112
1 0 1 0 0 1 0 1 1	75	546	10
1 0 1 0 0 1 1 0 0	76	538	72
1 0 1 0 0 1 1 0 1	77	530	150
1 0 1 0 0 1 1 1 0	78	524	88
1 0 1 0 0 1 1 1 1	79	518	38
1 0 1 0 1 0 0 0 0	80	512	0

Table 4-4 Sector Selection List (3/4)  
"EXCESS SECTOR MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	EXCESS SECTOR BYTES
F 1 0 2 6 2 5 2 4 2 3 2 2 1 2 0			
1 0 1 0 1 0 0 0 1	81	504	136
1 0 1 0 1 0 0 1 0	82	498	124
1 0 1 0 1 0 0 1 1	83	492	124
1 0 1 0 1 0 1 0 0	84	486	136
1 0 1 0 1 0 1 0 1	85	480	160
1 0 1 0 1 0 1 1 0	86	476	24
1 0 1 0 1 0 1 1 1	87	470	70
1 0 1 0 1 1 0 0 0	88	464	128
1 0 1 0 1 1 0 0 1	89	460	20
1 0 1 0 1 1 0 1 0	90	454	100
1 0 1 0 1 1 0 1 1	91	450	10
1 0 1 0 1 1 1 0 0	92	444	112
1 0 1 0 1 1 1 0 1	93	440	40
1 0 1 0 1 1 1 1 0	94	434	164
1 0 1 0 1 1 1 1 1	95	430	110
1 0 1 1 0 0 0 0 0	96	426	64
1 0 1 1 0 0 0 0 1	97	422	26
1 0 1 1 0 0 0 1 0	98	416	192
1 0 1 1 0 0 0 1 1	99	412	172
1 0 1 1 0 0 1 0 0	100	408	160
1 0 1 1 0 0 1 0 1	101	404	156
1 0 1 1 0 0 1 1 0	102	400	160
1 0 1 1 0 0 1 1 1	103	396	172
1 0 1 1 0 1 0 0 0	104	392	192
1 0 1 1 0 1 0 0 1	105	390	10
1 0 1 1 0 1 0 1 0	106	386	44
1 0 1 1 0 1 0 1 1	107	382	86
1 0 1 1 0 1 1 0 0	108	378	136
1 0 1 1 0 1 1 0 1	109	374	196
1 0 1 1 0 1 1 1 0	110	372	40
1 0 1 1 0 1 1 1 1	111	368	112
1 0 1 1 1 0 0 0 0	112	364	192
1 0 1 1 1 0 0 0 1	113	362	54
1 0 1 1 1 0 0 1 0	114	358	148
1 0 1 1 1 0 0 1 1	115	356	20
1 0 1 1 1 0 1 0 0	116	352	128
1 0 1 1 1 0 1 0 1	117	350	10
1 0 1 1 1 0 1 1 0	118	346	132
1 0 1 1 1 0 1 1 1	119	344	24
1 0 1 1 1 1 0 0 0	120	340	160

Table 4-4 Sector Selection List (4/4)  
"EXCESS SECTOR MODE"

SECTOR SW (SW4)	SECTORS PER TRACK	BYTES PER SECTOR	EXCESS SECTOR BYTES
1 0 2 6 5 2 4 2 3 2 2 1 2 0			
1 0 1 1 1 1 0 0 1	121	338	62
1 0 1 1 1 1 0 1 0	122	334	212
1 0 1 1 1 1 0 1 1	123	332	124
1 0 1 1 1 1 1 0 0	124	330	40
1 0 1 1 1 1 1 0 1	125	326	210
1 0 1 1 1 1 1 1 0	126	324	136
1 0 1 1 1 1 1 1 1	127	322	66
1 0 0 0 0 0 0 0 0	128	320	0

## CHAPTER 5

### MAINTENANCE AID

The D2362 Disk Drive has switches, indicators, interface connectors for Operator Panel and Diagnostic Panel on the "LOGIC & SERVO" PWA for Maintenance supporting. The assignment of these functions is located on the front side of the "LOGIC & SERVO" PWA as shown in Figure 5-1.

#### 5.1 WRITE PROTECT SWITCH

The operation of the PROTECT toggle switch places the drive in the write protected mode.

#### 5.2 LED INDICATORS

##### 5.2.1 Ready

The green "RDY" indicator lights when the unit is up to speed, the heads are on cylinder, and even if a fault condition detected, the indicator holds as far as the basic Ready conditions are being satisfied.

##### 5.2.2 Fault

The red "FLT" indicator lights up if a fault exists within the drive. (Refer to Table 6-4)

It is turned off;

- Receiving a Fault Clear command
- A drive power up operation

##### 5.2.3 Seek Error

The orange "SKE" indicator lights up if a seek error exists within the drive. (Refer to Table 6-5)

It is turned off;

- Receiving a Return-to-Zero command
- A drive power up operation

### 5.3 INTERFACE FOR OPERATOR PANEL

The Disk Drive provides an interface (indicated here) for connecting the operator panel in a system requiring an operator panel function. Refer to Appendix-D for details of 752 FRONT PANEL option.

#### 5.3.1 Switch Function of Operator Panel

(1) STOP/(START) switch

Closing the RTN (=signal ground) signal and this signal line causes the DKU to enter in the motor stop mode. When in the open status, this places the DKU in the start mode.

The condition for DKU start is obtained by logical product with the POWER HOLD (HOLD) signal function of the "A" cable of the DKC interface.

(2) FAULT CLEAR switch function

Closing the RTN signal and this signal line instructs the DKU to disengage the "FAULT" status.

(3) PROTECT/(PERMIT) switch

Closing the RTN signal and this signal line places the DKU in the write protected status. When open, write is enabled. The "PROTECT" status for DKU corresponds to this signal function.

(4) UNIT ADDRESS switch ( $2^0, 2^1, 2^2$  and  $2^3$ )

Total 4 bits ( $2^0, 2^1, 2^2$  &  $2^3$ ) lines are received as the UNIT ADDRESS (or also called DEVICE NUMBER) bits and each of them are connected to the corresponding switch bits (5,6,7,8) of the "SW2" as assigned as the internal UNIT ADDRESS switches which are described in the item(1) of paragraph 4.4.1.

#### 5.3.2 Display Function of Operator Panel

As display functions, this panel permits drive outputs such as "READY", "FAULT" and "PROTECT" for light-emitting diodes (LED).

### 5.3.3 Operator Panel Interface Connector

The connector for an Operator panel is located on the "LOGIC & SERVO" PWA (P58).

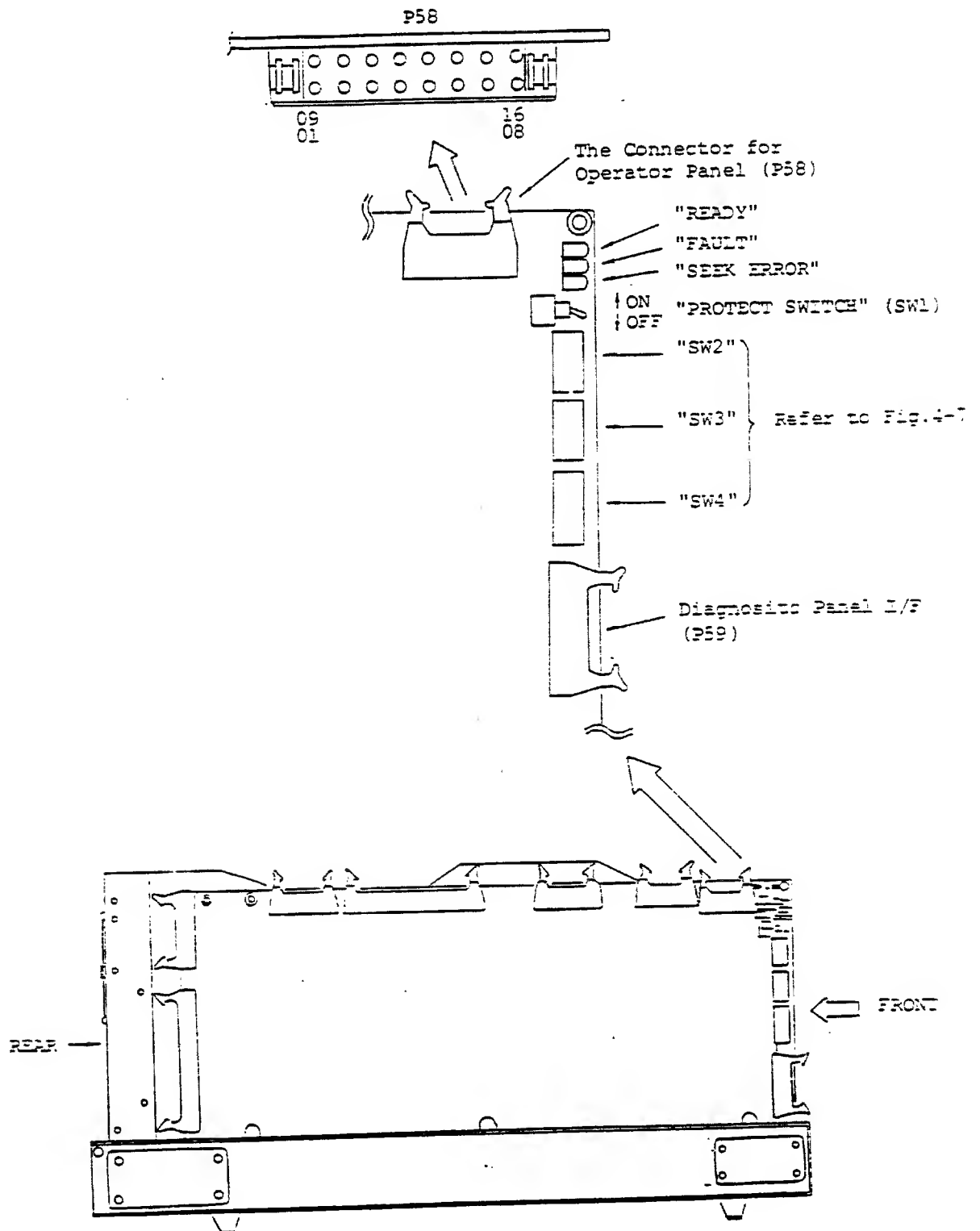


Figure 5-1 Operator Panel Interface Connector

### 5.3.4 Operator Panel Reference Circuit Diagram

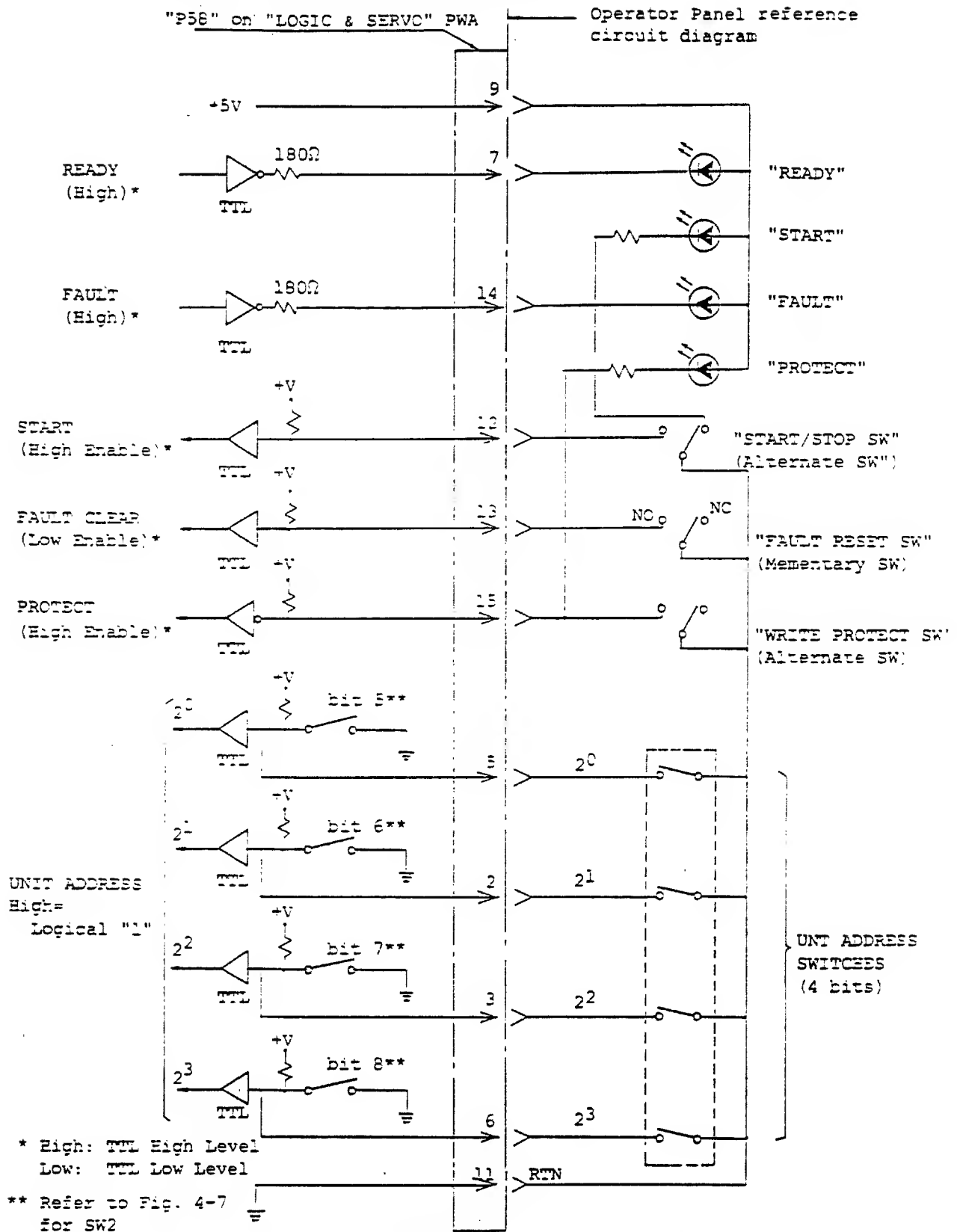


Figure 5-2 Operator Panel Reference Circuit Diagram



#### 5.4 INTERFACE FOR DIAGNOSTIC PANEL (P59)

The Disk Drive provides a connector for interfacing a Diagnostic Panel in a maintenance requirements. Normally the SD231 Status Display Panel Option is connected on this connector, but the 747-HLOG Diagnostic Panel is able to connect on the connector exclusively to the Status Panel.

The details of the Status Display is shown in Appendix-E.



## CHAPTER 6

### INTERFACES

#### 6.1 Interface Definition

All input and output signals are digital, utilizing industry standard transmitters and receivers. When used with properly shielded cables, this interface provides a terminated, differential transmission system for long distances and/or noisy electrical environments. Figure 6-1 is a block diagram of the drive interface.

Both the "A" and "B" cables are shielded to meet FCC requirements. Shielding is utilized to minimize cross-talk, reduce inductive coupling and susceptibility due to static discharges as well as control impedance variations regardless of cable lay.

The maximum number of drives connected to the "A" cable is 16. The maximum cumulative length of the "A" cable is 30 m. The maximum individual length of the "B" cable is 15 m.

##### 6.1.1 Terminated, Balanced Transmission System

The transmitter is connected to the I/O line such that the output of the transmitter labeled Z corresponds with the low order pin number of the pin assignments and, in turn, connects to receiver pin. When the transmitter and receiver are connected in this manner, a logical 1 into the transmitter produces a logical 1 out of the receiver. The single exception to this rule shall be the Unit Selected line in which the transmitter output labeled Z, connected to the low order pin of the pin assignments, is connected to the receiver input pin.

Transmitters and Receivers are industry standards.

##### 6.1.2 Clock and Data Signals (For "SMD-E" Type Interface Drive Only)

The following devices are used on the SMD-E Clock/Data I/O signals:

Transmitter	10192
Receiver	10114

NOTE: 15 MHz controllers may use industry standard TTL 75110A transmitters and MC 3450 receivers in conjunction with the above disk drive ECL components; they are electrically compatible on the interface.

All other signals use the transmitter and/or receiver defined in 6.1.3.

#### 6.1.2.1 Clock and Data Transmitter Characteristics (10192)

The SMD-E clock/data transmitter (Figure 6-3) is compatible with the line receiver described in 6.1.2.2.

1. Clock and Data Line output Signal Levels:

0.74 V minimum, 1.06 V maximum.

2. Transmitter propagation time:

1.5 ns minimum, 4.5 ns maximum.

#### 6.1.2.2 Clock and Data Receiver Characteristics (10114)

The SMD-E clock/data receiver (Figure 6-3) is compatible with the data transmitter described in 6.1.2.1.

1. Clock and Data Line Input Signal Levels:

0.74 V minimum, 1.06 V maximum.

2. Receiver propagation time:

1 ns minimum, 4 ns maximum.

#### 6.1.3 Control Signals

The following devices are used on the Control I/O signals:

Transmitter	75110A
Receiver	MC 3450

(Also these devices are used on the Clock and Data Signals for the "SMD" = Conventional TTL type interface drive)

#### 6.1.3.1 Control Transmitter Characteristics (75110A)

1. Control Line Output Signal Levels:

0.21 V minimum, 0.41 V maximum.

2. Transmitter propagation time:

9 ns typical, 15 ns maximum.

### 6.2.2 Address and Control Tag

Address and control functions are transferred over 13 signal lines; that is, 10 (bit) bus lines and 3 tag lines. Table 6-1 shows how the data is decoded on these lines.

#### 6.2.2.1 Bus Lines (Bits 0 through 9)

The 10 bus lines transmit address and control signals from the disk drive controller to the disk drive in conjunction with the tag lines. Stabilize the bus lines before any of the tag lines become active.

#### 6.2.2.2 Tag 1 (Cylinder Address)

Tag 1 enables the transfer of the new cylinder address to the disk drive by the bus lines. When Tag 1 is accepted by the disk drive, the actuator moves to the specified cylinder. Tag 1 also serves as a strobe signal to determine the effective period of the bus lines.

#### 6.2.2.3 Tag 2 (Head Select)

Tag 2 transfers the head select (address) by the bus lines. Tag 2, like Tag 1, also serves as a strobe signal to determine the effective period of the bus line. The timing among Tag 1, Tag 2, and the bus line signals is shown in Figure 6-7.

#### 6.1.3.2 Control Receiver Characteristics (MC 3450)

The control receiver (Figure 6-2) is compatible with the transmitter described in 6.1.3.1.

##### 1. Control Line Input Signal Levels:

0.21 V minimum, 0.41 V maximum.

##### 2. Control Receiver propagation time:

17 ns typical, 25 ns maximum.

#### 6.1.4 Terminator

##### 6.1.4.1 "A" Cable

A termination resistance, illustrated in Figures 6-1 and 6-2 is required at the transmitter and receiver end of each transmission line of the "A" cable. This resistance is provided on the drive end by the terminator assembly, see Table 8-3, and Figures 8-1 and 8-2.

##### 6.1.4.2 "B" Cable

A termination resistance, illustrated in Figures 6-3(a) and 6-3(b) is required at the receiver end of each transmission line of the "B" cable. This resistance is provided at the units receiver logic card.

#### 6.2 CABLE A SIGNALS

Cable A transmits address and control data as well as drive status. Signal polarity for the interface signals is shown in Figures 6-1 and 6-2.

##### 6.2.1 Unit Select

Device select operation is performed by signals on the Unit Select bit 2<sup>0</sup> - 2<sup>3</sup>, and Unit Select Tag Lines.

##### 6.2.1.1 Unit Select 2<sup>0</sup> through 2<sup>3</sup>

The signals on these four lines are binary-coded (0 to 15) to select the logical number of one of sixteen drives. The disk drive number, 0 (HEX) through F (HEX), is selected by logic number switches in the logic printed wiring assembly (PWA). (Do not assign duplicate logic numbers to drives in the same system.)

##### 6.2.1.2 Unit Select Tag

The Unit Select Tag signal selects a particular disk drive. This signal gates the logic number into the logic number compare circuit. One of the disk drives is selected after the leading edge of this signal has occurred. The Unit Select Timing is shown in Figure 6-6.

Table 6-2 Tag 3 Control Functions

BITS	FUNCTION	DESCRIPTION																
0	Write Gate	<p>This signal enables the write operation on the specified track/sector. This signal is validated under the following conditions:</p> <table><tr><td>Unit Ready</td><td>True</td></tr><tr><td>On Cylinder</td><td>True</td></tr><tr><td>Seek End</td><td>True</td></tr><tr><td>Seek Error</td><td>False</td></tr><tr><td>Fault</td><td>False</td></tr><tr><td>Channel Ready</td><td>True</td></tr><tr><td>File Protect</td><td>False</td></tr><tr><td>Offset</td><td>False</td></tr></table> <p>If Write Gate is turned on in cases other than the above-mentioned conditions, Fault occurs and writing is inhibited. Refer to the definition of Fault.</p>	Unit Ready	True	On Cylinder	True	Seek End	True	Seek Error	False	Fault	False	Channel Ready	True	File Protect	False	Offset	False
Unit Ready	True																	
On Cylinder	True																	
Seek End	True																	
Seek Error	False																	
Fault	False																	
Channel Ready	True																	
File Protect	False																	
Offset	False																	
1	Read Gate	<p>This signal is used to read data from the specified track/sector. Refer to the definition of Read Gate, Read Data and 1F Read Clock.</p> <p>The leading edge of the Read Gate triggers the read chain to synchronize on an all zeros pattern.</p>																
2	Servo offset Plus	<p>This signal is used to recover an error and the head is offset <u>1.0 <math>\mu\text{m}</math></u> in an outward direction. The unit will issue On Cylinder and Seek End signals to the controller when the operation is completed. Refer to Figure 6-10.</p>																
3	Servo offset Minus	<p>This signal is used to recover an error and the head is offset <u>1.0 <math>\mu\text{m}</math></u> in an inward direction. This unit will issue On Cylinder and Seek End signals to the controller when the operation is completed. Refer to Figure 6-10.</p>																
4	Fault Clear	<p>Sends pulse to the disk drive to clear the fault flip-flop if the fault condition no longer exists. The pulse width of Fault Clear should be more than 100 ns.</p>																
5	Address Mark Enable	<p>In conjunction with WRITE GATE, causes an address mark write. In conjunction with READ GATE, causes an address mark search.</p>																

Table 6-1 Tag/Bus Decode

BUS OUT	TAG1 CYLINDER SELECT*	TAG2 HEAD SELECT	TAG3 CONTROL SELECT	TAG4 SENSE SELECT	UNIT SELECT TAG
Bit 0	(LSB) 1	(LSB) 1	Write Gate		
Bit 1	2	2	Read Gate		
Bit 2	4	4	Servo Offset (+)		
Bit 3	8	8	Servo Offset (-)		
Bit 4	16	(MSB) 16	Fault Clear		
Bit 5	32	-	AM-Enable		
Bit 6	64	-	Return to Zero		
Bit 7	128	-	Strobe Early		
Bit 8	256	-	Strobe Late	Select bit 8	
Bit 9	(MSB) 512	-	(Release)*1	Select bit 9	(Priority Select)*1
* LSB means least significant bit; MSB means most significant bit.					

( )\*1: Dual-port Command

#### 6.2.2.4 Tag 3 (Control Select)

Tag 3 transfers control information to the disk drive. The control functions are listed in Table 6-2.



Table 6-2 Tag 3 Control Functions (Cont'd)

BIT	FUNCTION	DESCRIPTION
6	Return-to Zero	Moves the actuator to cylinder 000 and resets the head address register, and also clears the seek error flip-flop. (This seek operation is significantly longer than a normal seek to cylinder 000 and should only be used for recalibration.) The pulse width of Return-to-Zero should be more than 100 ns but less than 1.0 ms.
7	Data Strobe Early	Strobes data early. When this signal is active (LOW) and Read Gate is true (LOW), the data separator strobes the data earlier than normal. Normal strobe timing is returned when this signal becomes inactive.
8	Data Strobe Late	Strobes data late. When this signal is active (LOW) and the Read Gate is true (LOW), the data separator strobes the data later than normal. Normal strobe timing is returned when this signal becomes inactive (HIGH).
9	Release	Used with dual-port option only. Refer to additional description for the dual-port option.

### 6.2.3 Sense Lines

Whenever certain status conditions occur in the disk drive, eight signals are sent by Cable A from the selected disk drive to the controller. If the Tag 4 is active (HIGH), these sense lines serve as Bus-In bit0 (BIO) through Bus-In Bit7 (BI7). When the tag 4 is inactive (LOW), these lines are used for normal status conditions, as described in Sections 6.2.3.1 through 6.2.3.8.

#### 6.2.3.1 Index

The Index signal is transmitted to the disk drive controller when the index pattern on the disk drive surface is detected. The leading edge of the Index signal is considered the leading edge of Sector 0.

The Index timing integrity is sustained throughout seek operations. The Index signal is only valid when the disk drive is in the Unit Ready status.

#### 6.2.3.2 Sector

The Sector signal is driven by the servo byte clock from the servo track and is valid when the disk drive is in the Unit Ready state. Timing integrity is maintained throughout seek operations. The number of sectors per revolution can be selected by a switch mounted on a logic PWA. Figure 6-11 shows the timing relationship between the Index and Sector signals.

#### 6.2.3.3 Fault

When the disk drive detects a fault, a Fault signal is generated and the disk drive immediately switches to the Write Protect state to prevent data destruction. The Fault signal is activated by one of the nine status conditions shown in Table 6-4. This line can be cleared by the reset procedures when the fault condition no longer exists.

The fault conditions detected by the disk drive can be grouped into the following four categories:

- Interface Signal Related Faults

The Interface Controller recognizes these illegal operations; (a) by a signal from the Interface Write gate during a read operation, (b) by a signal from the Write or Read gate when the wrong disk recording cylinder is in use, or (c) by a signal from the Write gate whenever a Write-Protected-Volume operation is violated.

- Hardware Unsafe Faults

These faults indicate data R/W failures caused by an open or shorted head, the loss of write current, or the loss of write data during the write gate time.

- Hardware Detected Faults That Cause Head Retract

These faults indicate the loss of internal spindle motor speed control or an improper servo positioning operation forcing the retraction of the R/W heads. This type of fault may be created with the absence of a servo or a  $\pm 5$ ,  $\pm 12$ ,  $+38$  dc voltage from the disk drive electronics.

- Microcomputer Detected Faults

These faults can be created by the inability of the servo phase lock oscillator to maintain frequency synchronization for servo positioning control or data field write control, out of tolerance spindle motor speed, detection of the R/W heads positioned outside the valid data zones of the disk drive, and finally, a failure of the drive to pass the power turn-on self test functions. A microcomputer within the disk drive continuously monitors drive performance to determine safe and reliable operation of the servo and spindle motor electronics.

#### 6.2.3.4 Seek Error

The Seek Error signal activates when the disk drive detects one of the fault status conditions shown in Table 6-5. When a seek error status is detected, the disk drive immediately assumes the Write Protect state to prevent data destruction. The Seek Error signal can only be cleared by performing a Return-to-Zero function.

#### 6.2.3.5 On Cylinder

The On Cylinder signal indicates that the actuator has positioned itself on a track. This signal is reset, with any seek instruction causing actuator movement or a zero track seek (see Figures 6-8 and 6-9).

#### 6.2.3.6 Unit Ready

The Unit Ready signal indicates that the selected disk drive is up to speed and the heads are in the regular position (not in a home position). This signal is inactive when the Unit Select Tag is not sent to the disk drive or if the disk drive detects any fault condition. However, when the Unit Ready signal is active, the disk drive can perform seek, read, and write operations.

#### 6.2.3.7 Write Protect

The Write Protect signal signifies that the write PROTECT switch is turned on. In the Write Protect status, a write operation is not executed.

#### 6.2.3.8 Address Mark Found

When Read Gate and AM Enable are simultaneously set, the disk read circuit searches AM, and when it encounters 3 bytes of DC-erased area, the unit will issue the Address Mark Found signal to the controller.

The Address Mark Found is sent to the controller following recognition of at least 16 missing read raw data bits and the first four bits of the zero pattern on the PLO Sync area of the track format.

The controller should drop the Address Mark Enable upon receiving the Address Mark Found and valid data will be transferred to the controller. The drive detects that the AM Enable is inactive.

Under certain conditions, it is possible the drive could issue a false Address Mark Found during an address mark search operation. This would occur if a media defect existed which simulated the electrical characteristics of an address mark at least 16 bits erased area followed by a zero.

It is recommended provisions be made in system hardware, firmware, or software to allow recovery from, or avoid the possibility of detecting a false AM Found. (See Figure 6-12)

#### 6.2.3.9 Busy (Dual Port Mode)

The Busy signal is issued to the controller when the Unit Select Tag is received from the port while the drive is already reserved and/or selected from the opposite port. Refer to the additional description for the Dual-Port Option.

#### 6.2.4 Control Lines

Two signals are sent to the disk drive to detect a possible break in the Cable A signal and to determine the status of the power sequence. The two signals are called the Open Cable Detector and the Spindle Motor Control signals.

##### 6.2.4.1 Open Cable Detector

The Open Cable Detector signal disables the interface when Cable A is disconnected or when the controller has lost power. It is recommended that the controller has sufficient voltage margins and interlocks to prevent operation with the disk drive before the controller is in the ready state or before impending controller power failure.

##### 6.2.4.2 Spindle Motor Control

The Hold Line (see Figure 6-4) enables the interface to start or stop the spindle motor provided the dc power is on and the Remote/Local jumper is in the Remote position. Activation of the Hold input (that is, a logic 1 or LOW level) initiates rotation of the spindle motor, which comes up to speed within 30 seconds after application of the hold signal. This condition is reflected in the interface Ready line. The spindle motor stops about 15 seconds after deactivating the hold line (see Figure 6-13).

#### 6.2.5 Tag 4 (Optional Feature)

As an extended Interface feature, an Error detail status, the Device Type Code, or RPS Sector of the disk drive, is sent back to the controller by enabling the Tag 4 line in conjunction with the Bus lines Bit 8 and Bit 9.

A Summary of the Tag 4 operations is shown in the Table 6-3.

Table 6-3 Tag 4 Operations

<div> <div>Tag State</div> <div>Bus Stage</div> </div>	Tag 4=0 DISABLE	Tag 4 = 1 : ENABLE			
	SUMMARY STATUS	READ DETAIL STATUS	DEVICE TYPE	READ SECTOR	RESET PRIORITY SELECT
<div> <div>BIT 0</div> <div>↓</div> <div>BIT 7</div> </div>	DON'T CARE	DON'T CARE	DON'T CARE	DON'T CARE	DON'T CARE
BIT 8	DON'T CARE	0	0	1	1
BIT 9	DON'T CARE	0	1	0	1
(BI0) INDEX	Index	<div> <div>ENCODED</div> <div>"ERROR"</div> <div>CODE</div> <div>(HEXDEC)</div> </div>	2 <sup>0</sup> DT0	2 <sup>0</sup> (1)	Index
(BI1) SECTOR	Sector		2 <sup>1</sup> DT1	2 <sup>1</sup> (2)	Sector
(BI2) FAULT	Fault		2 <sup>2</sup> DT2	2 <sup>2</sup> (4)	Fault
(BI3) SEEK ERROR	Seek Error		2 <sup>3</sup> DT3	2 <sup>3</sup> (8)	Seek Error
(BI4) ON CYLINDER	On Cylinder	<div> <div>ENCODED</div> <div>"STATE"</div> <div>CODE</div> <div>(HEXDEC)</div> </div>	2 <sup>0</sup> DT4	2 <sup>4</sup> (16)	On Cylinder
(BI5) UNIT READY	Unit Ready		2 <sup>1</sup> DT5	2 <sup>5</sup> (32)	Unit Ready
(BI6) AM FOUND	AM Found		2 <sup>2</sup> DT6	2 <sup>6</sup> (64)	AM Found
(BI7) WRT PROTECTED	Protected		2 <sup>3</sup> DT7	0	Protected

#### 6.2.5.1 Read Detail Status (TAG4·BIT8·BIT9)

A 8-bit Encoded Detail error Status is sent back to the controller when the Tag4 is active, and Bus Bit 8 and Bit 9 is inactive (=0).

Each Error Code and Detail Error cause which enables "Fault" Sense line are shown in Table 6-4. And each error code and detail error cause for "Seek Error" line are shown in Table 6-5.

Table 6-4 Detail Status for "FAULT" Sense

STAGE DESCRIPTION	CODE STATE.ERROR	ERROR DESCRIPTION
POWER ON INITIALIZE	1 1 2 4	VOLTAGE FAULT ROM FAULT FAULT LATCH
STOP MODE	2 1	VOLTAGE FAULT
START WAIT	3 1	VOLTAGE FAULT
MOTOR INITIATING	4 1 3 4	VOLTAGE FAULT NOT MOTOR SPEED UP NOT ROTATION
MOTOR SPEED UP	5 1 2 3	VOLTAGE FAULT MOTOR SPEED TOO SLOW MOTOR SPEED TOO HIGH
MOTOR SPEED OK	6 1 2 3	VOLTAGE FAULT MOTOR SPEED LOSS MOTOR SPEED OVER
LOCK SERVO PLO	7 1 2	VOLTAGE FAULT MOTOR SPEED LOSS
RECALIBRATE OUT	8 1	VOLTAGE FAULT
RECALIBRATE IN	9 1	VOLTAGE FAULT
READY (ON CYLINDER)	A 1 2 3	VOLTAGE FAULT MOTOR SPEED LOSS MOTOR SPEED OVER
MOVE OUT (SEEK)	B 1	VOLTAGE FAULT
INTERFACE CHECK	C 3	TAG1 WHILE NOT READY
MOVE IN (SEEK)	D 1	VOLTAGE FAULT

Table 6-4 Detail Status for "FAULT" Sense (Cont'd)

STAGE DESCRIPTION	CODE STATE.ERROR	ERROR DESCRIPTION
"FAULT" DETECTED	F 1	PROTECT
	2	VIOLATION+READ.WRITE (UNIT READY + ON CYL).WRITE
	3	WRITE CLOCK FAULT
	4	OFF TRACK. WRITE
	5	WRITE.MARS UNSAFE
	6	READ.MARS UNSAFE

Table 6-5 Detail Status for "SEEK ERROR" Sense

STAGE DESCRIPTION	CODE STATE.ERROR	ERROR DESCRIPTION
LOCK SERVO PLO	7 4 5	LOSS OF INDEX NO IGB FOUND
RECALIBRATE OUT	8 4 5 6 7 8 9 C D	LOSS OF INDEX NO OGB FOUND NO N LIN FOUND NO HALF TRACK FOUND NO Q LIN FOUND NO DIFF=0 FOUND OVER SHOOT CHECK OVER SHOOT CHECK
RECALIBRATE IN	9 4 5 9 C D	LOSS OF INDEX NO OGB FOUND NO N LIN FOUND OVER SHOOT CHECK OVER SHOOT CHECK
READY (ON CYLINDER)	A 4 C	LOSS OF INDEX OFF TRACK
MOVE OUT	B 4 9 C D E F	LOSS OF INDEX NO DIFF=0 FOUND OVER SHOOT CHECK OVER SHOOT CHECK OVER TRAVEL (OGB) OVER TRAVEL (IGB)
INTERFACE CHECK	C 1	INVALID CYL ADDRESS

Table 6-5 Detail Status for "SEEK ERROR" Sense (Cont'd)

STAGE DESCRIPTION	CODE STATE.ERROR	ERROR DESCRIPTION
MOVE IN	D 4	LOSS OF INDEX
	9	NO DIFF=0 FOUND
	C	OVER SHOOT CHECK
	D	OVER SHOOT CHECK (TIME OUT)
	E	OVER TRAVEL (OGB)
	F	OVER TRAVEL (IGB)
SEEK CALIBRATION	E 1	SEEK UNSUCCESSFUL
	E 2*	SEEK SPEED TOO LOW*
	E 3*	SEEK SPEED TOO HIGH*
	E 4	NOT PLO GOOD IN OFFSET
	E 5	OFF-TRACK IN OFFSET SEEK
	E 6	OFFSET COMMAND WHILE NOT ON-CYLINDER STATE
	E 7*	SET SEEK SPEED LOWER

\*: THESE STATUS ARE NOT SENT A "SEEK ERROR" REPORT TO DKC, ONLY  
DISPLAYED ON THE DIAGNOSTIC PANEL. [E2, E3, \*E7.]

#### 6.2.5.2 Device Type Request

Tag 4 with Bus Bit 8 (Inactive) and Bit 9 (Active) are sent to the disk drive to fetch the device type code; it is then sent back to the controller where it is interrogated for the type model address.

When Tag4·Bit8·Bit9 is active, a specified device type code is sent to the controller over sense lines BI0 through BI7 (See Table 6-1)

#### 6.2.5.3 Read Sector

When Tag4 and Bus Bit8 are "Active" and Bus Bit9 is "Inactive", a 8-bit count number of the SECTOR COUNTER is sent back to the controller. The SECTOR COUNTER is reset to zero (00) by each index pulse, then incremented by one for following sector pulse.

The read sector command is used for Rotational Position Sensing (RPS) function. (Sector Switches should be set to "128" Sectors.)



#### 6.2.5.4 Reset Priority Select

When Tag4, Bus Bit8 and Bus Bit9 are active, a "Reset Priority Select" operation is executed in the disk drive with Dual Port Option.

Detail description of this command, refer to the additional specifications for the Dual Port Option.

### 6.3 CABLE B SIGNALS

Cable B carries the read/write data and clock signals between the controller and the drive (see Figure 6-5). It also carries the drive status from the disk drive to the controller on different lines.

#### 6.3.1 Data and Clock Lines

The data and clock lines are composed of five transmission lines: three write lines (Write Data, Write Clock, and Servo Clock) and two read lines (Read Data and Read Clock).

##### 6.3.1.1 Write Data

This line transfers data to be recorded on the disk drive.

##### 6.3.1.2 Write Clock

Write Clock, synchronized to the Write Data, is the Servo Clock retransmitted to the drive by the controller during a write operation. The Write Clock need not be transmitted continuously, but must be transmitted at least 2.5 bits before the Write Gate.

##### 6.3.1.3 Servo Clock

Servo Clock is a phase-locked signal generated from the servo track tripulse. Servo Clock is available at all times in the Ready state. The Write timing, illustrating the relationship between Write Data, Write Clock, and Servo Clock, is shown in Figures 6-17 and 6-18; timing is at the input to the interface cable connector of the drive.

##### 6.3.1.4 Read Data

This line transmits the recovered data in NRZ form to the controller.

##### 6.3.1.5 Read Clock

Read Clock defines the beginning of a data cell. It is internally generated and is synchronous with the detected read-back signals. This line is transmitted continuously and is in phase-sync within a 7-byte period after the Read Gate. The Read timing, depicting the relationship between the Read Data and Read Clock signals, is shown in Figure 6-19.

### 6.3.2 Dedicated Sense Lines

Dedicated lines are those used for specific purposes only and not shared for other functions. The special purpose lines are described as follows.

#### 6.3.2.1 Seek End

Seek End is issued to the controller when a seek operation has been completed or 30 us (nominal) after the zero seek (see Figures 6-8 and 6-9).

#### 6.3.2.2 Unit Selected (Single Port Mode)

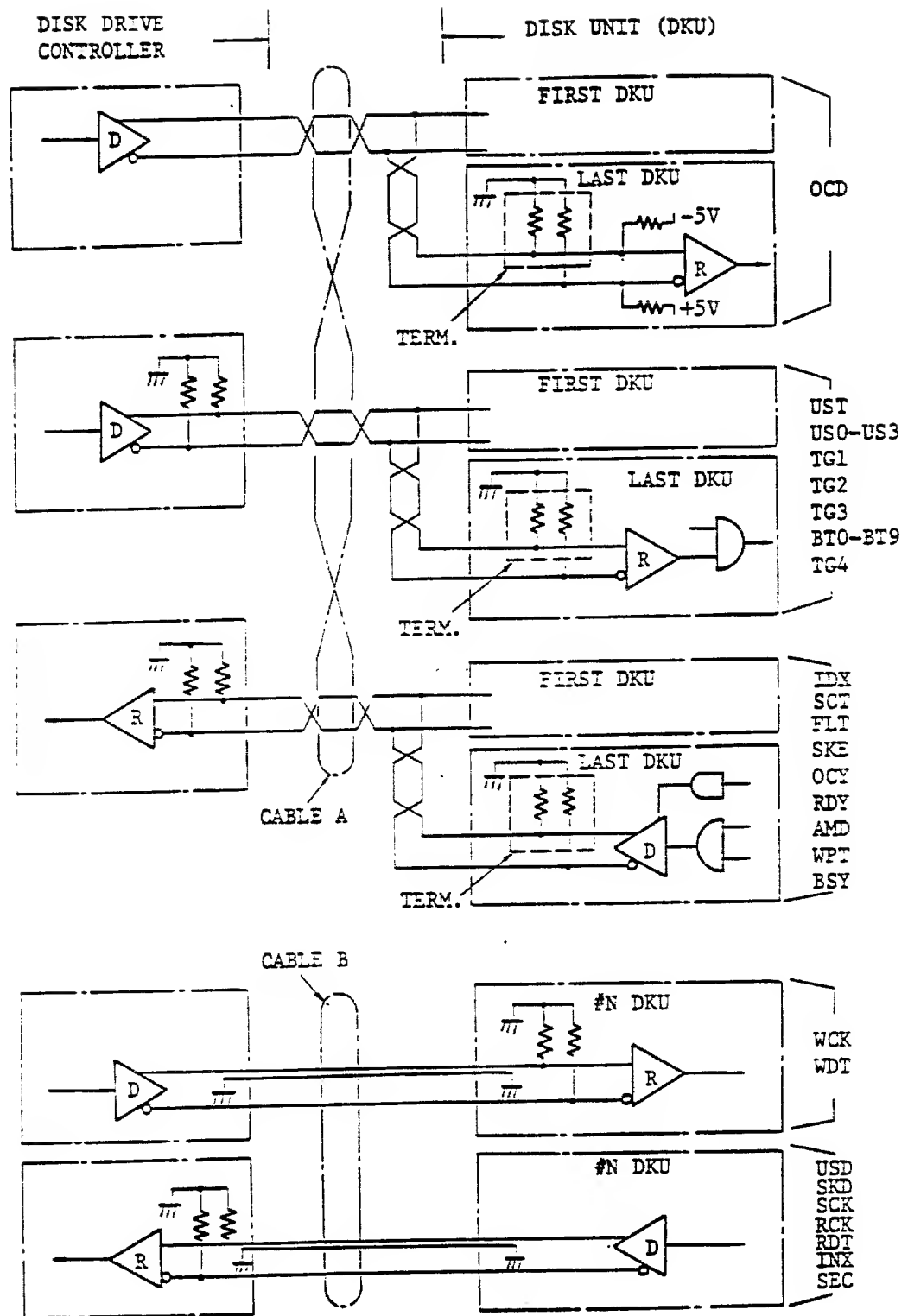
Unit Selected is active (HIGH) when Unit Select lines are compared to the logic number in the logic chassis and when the leading edge of Unit Select Tag is received. The Unit Select timing is shown in Figure 6-6.

#### 6.3.2.3 Index

This signal is described in Section 6.2.3.1 and is not gated by the Unit Selected signal.

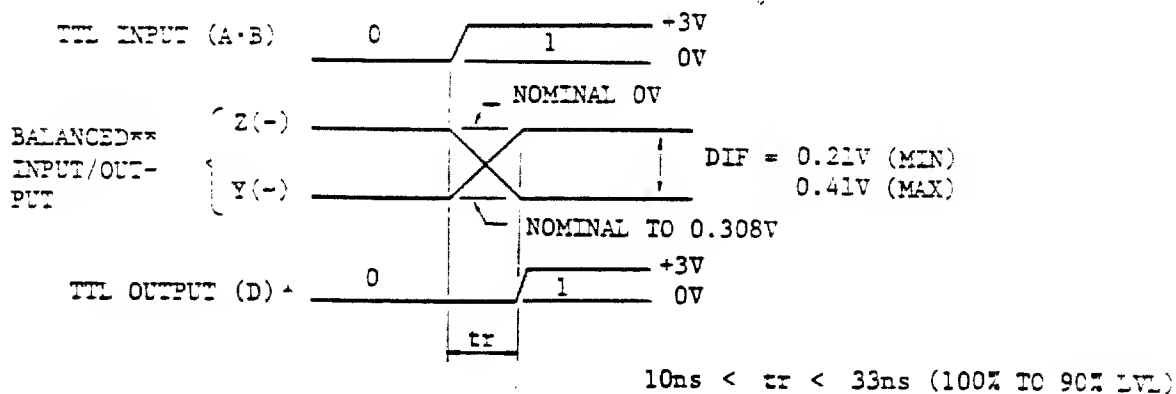
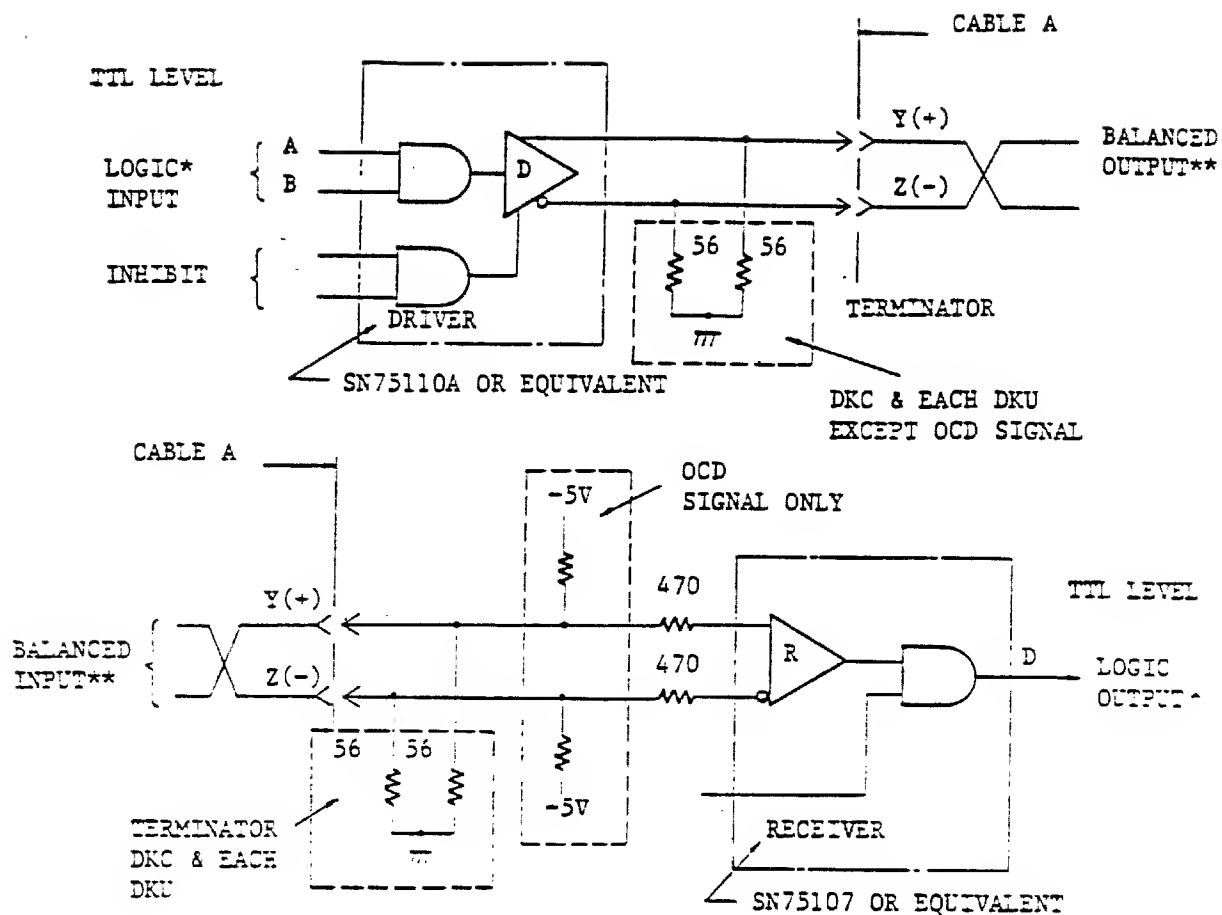
#### 6.3.2.4 Sector

This signal is described in Section 6.2.3.2 and is not gated by the Unit Selected signal.



NOTE: D MEANS DRIVER  
R MEANS RECEIVER  
DKU MEANS DISK UNIT

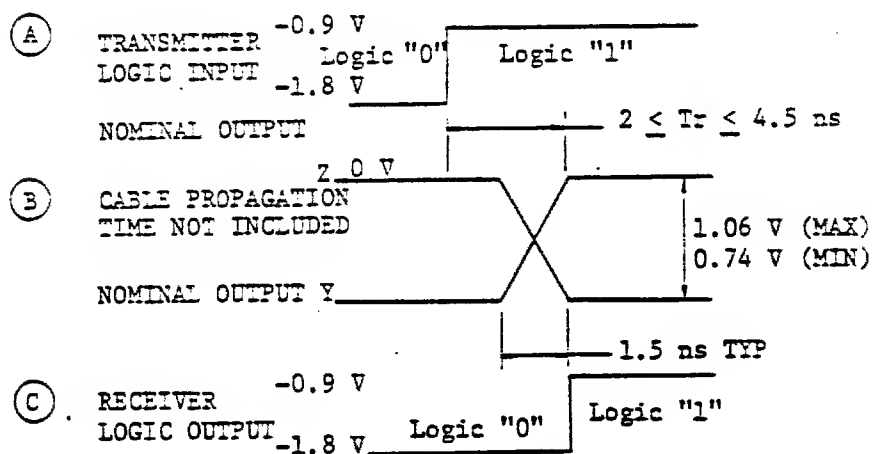
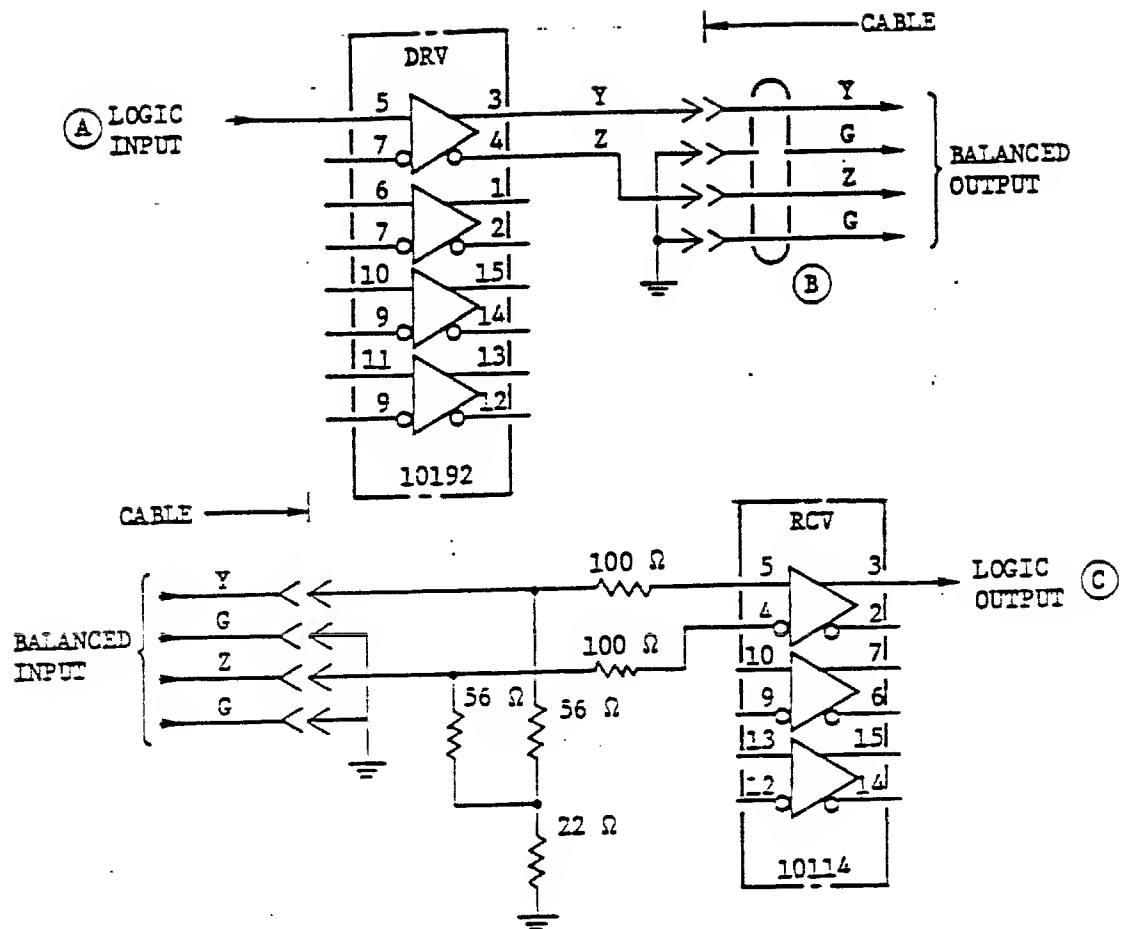
Figure 6-1 Interface Circuits



- \* CABLE CHARACTERISTIC IMPEDANCE IS  $100 \pm 10 \Omega$ .
- \*\* CABLE LENGTH IS A MAXIMUM OF 30 m.
- + NUMBER OF CONDUCTORS IS A MAXIMUM OF 60

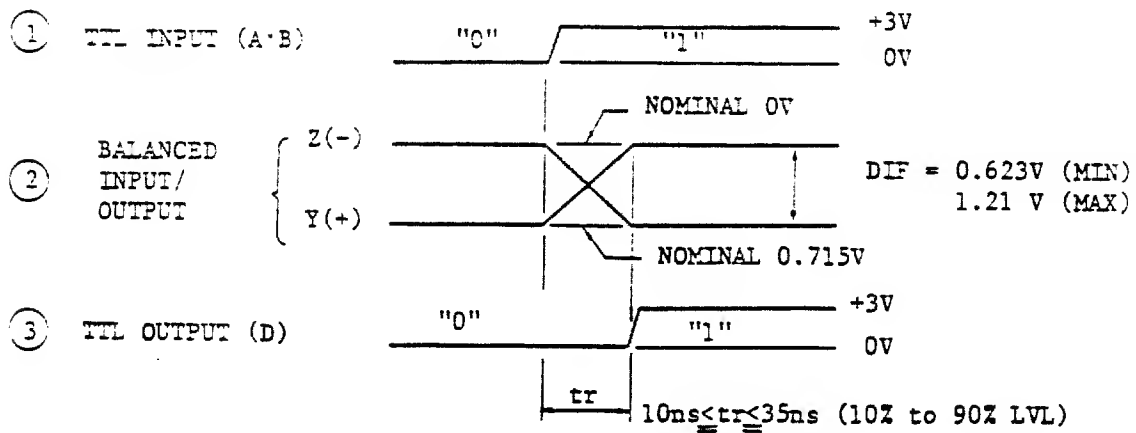
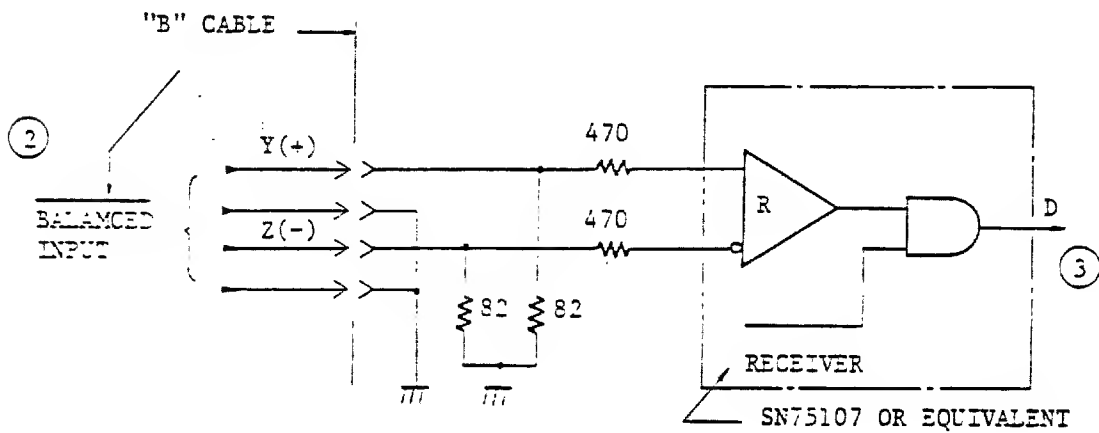
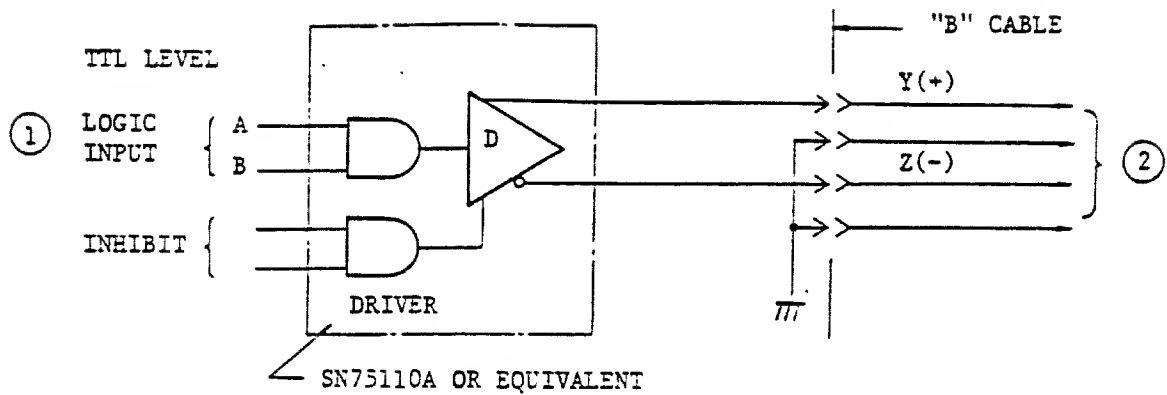
NOTES: 1. DKC MEANS DISK DRIVE CONTROLLER  
2. DKU MEANS DISK DRIVE UNIT

Figure 6-2 Cable A Line Transmitter and Receiver



CABLE IS SHIELDED WITH CHARACTERISTIC IMPEDANCE OF  $100 \pm 10 \Omega$ .  
 FOR LOGIC LEVELS AND TRUTH TABLE. REFER TO TRANSMITTER AND RECEIVER  
 FIGURES.  
 TERMINATOR RESISTORS ARE LOCATED ON DRIVE LOGIC CARD OR IN CONTROLLER.  
 THESE SIGNALS MUST BE START CABLED.

Figure 6-3(a) Data and Clock Line Transmitter and Receiver  
 ("SMD-E" Type Interface)



CABLE CHARACTERISTIC INPEDANCE:  $130 \pm 10\Omega$

CABLE LENGTH: MAX 15 m

Figure 6-3(b) Cable "B" Interface Circuit  
("SMD" Type Interface)

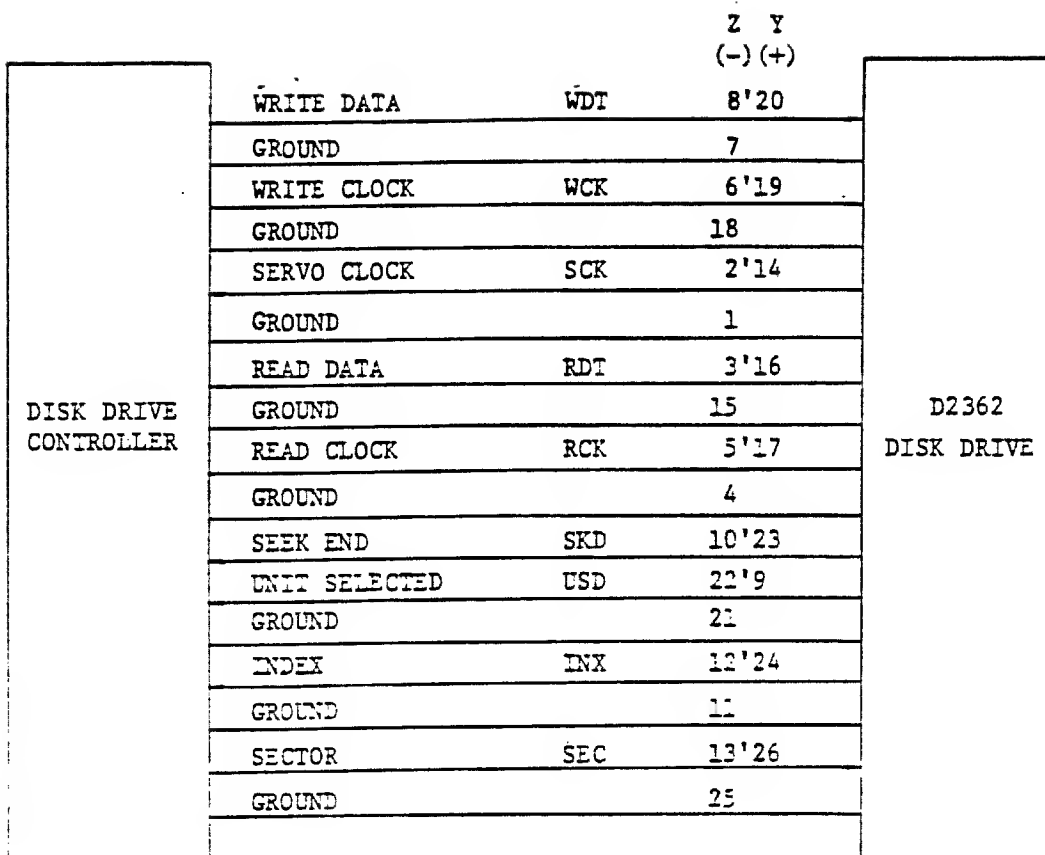
		Z Y (-)(+)
DISK DRIVE CONTROLLER	OPEN CABLE DETECT	OCD 14'44
	UNIT SELECT TAG	UST 22'52
	UNIT SELECT 2 <sup>0</sup>	US0 23'53
	UNIT SELECT 2 <sup>1</sup>	US1 24'54
	UNIT SELECT 2 <sup>2</sup>	US2 26'56
	UNIT SELECT 2 <sup>3</sup>	US3 27'57
	TAG 1*	TG1 1'31
	TAG 2*	TG2 2'32
	TAG 3*	TG3 3'33
	BIT 0*	BT0 4'34
	BIT 1*	BT1 5'35
	BIT 2*	BT2 6'36
	BIT 3*	BT3 7'37
	BIT 4*	BT4 8'38
	BIT 5*	BT5 9'39
	BIT 6*	BT6 10'40
	BIT 7*	BT7 11'41
	BIT 8*	BT8 12'42
	BIT 9*	BT9 13'43
	UNIT READY (BI5)*	RDY 19'49
	ON CYLINDER (BI4)*	OCY 17'47
	SEEK ERROR (BI3)*	SKE 16'46
	INDEX (BI0)*	IDX 18'48
	SECTOR (BI1)*	SCT 25'55
	AM-FOUND (BI6)*	AMD 20'50
	WRITE PROTECT (BI7)*	WPT 28'58
	FAULT (BI2)*	FLT 15'45
	TAG4*	TG4 30'60
	(BUSY)*	(BSY) 21'51
	SEQUENCE HOLD	HOLD 59
	(SPARE)	(PICK)\$ 29
		D2362 DISK DRIVE UNIT

(BUSY) is available when Dual-port is existing.

( )\$ Not used.

\* Denotes gated signal from selected unit.

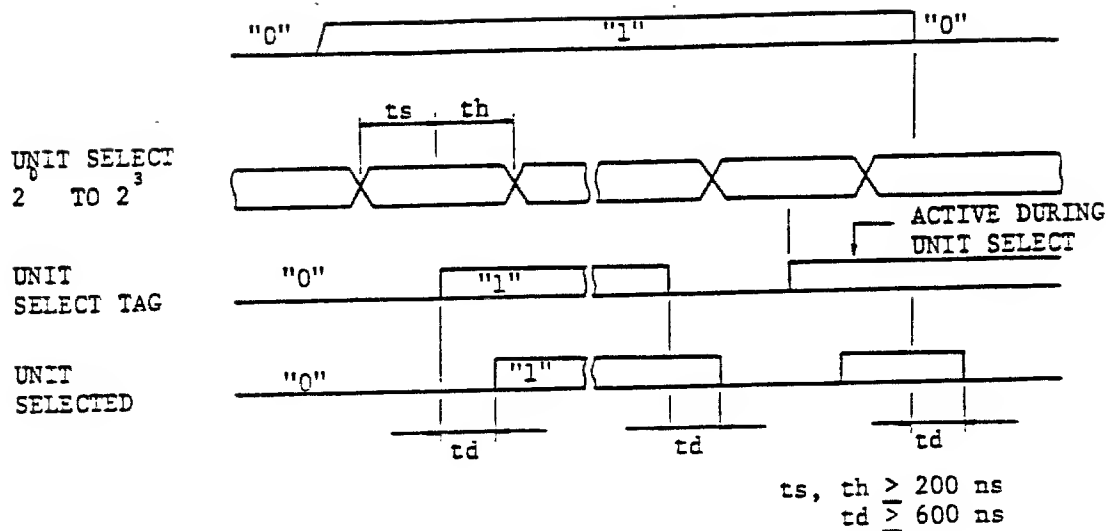
Figure 6-4 Cable A Signals



- NOTES: 1. A 26-CONDUCTOR FLAT CABLE  
 2. NO SIGNALS ARE GATED BY CABLE A UNIT SELECT

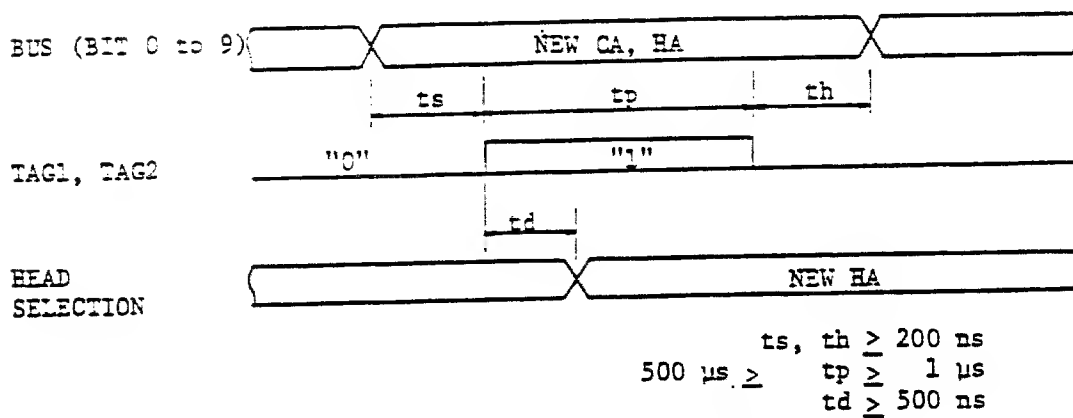
Figure 6-5 Cable B Signals





NOTE: TIMING SHOWN IS AT INPUT TO INTERFACE  
CABLE CONNECTOR OF DRIVE

Figure 6-6 Unit Select Timing



NOTE: TIMING IS AT INPUT TO INTERFACE CABLE  
CONNECTOR OF DRIVE

Figure 6-7 Tag/Bus Timing

$500 \mu s \geq$      $tp \geq 1 \mu s$   
 $ts, th \geq 200 ns$   
 $td \geq 120 ns$

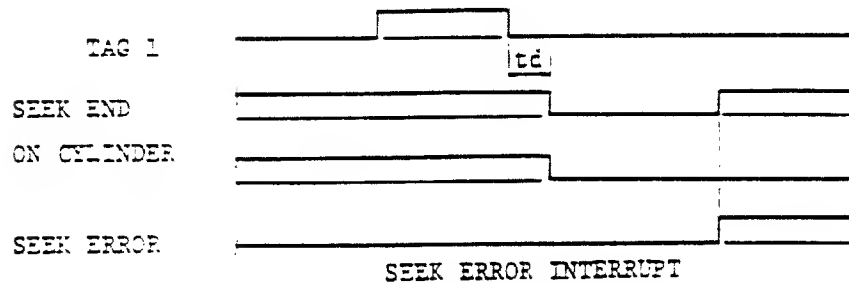
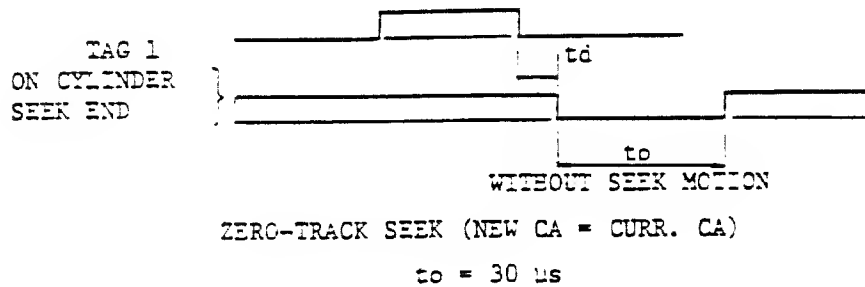
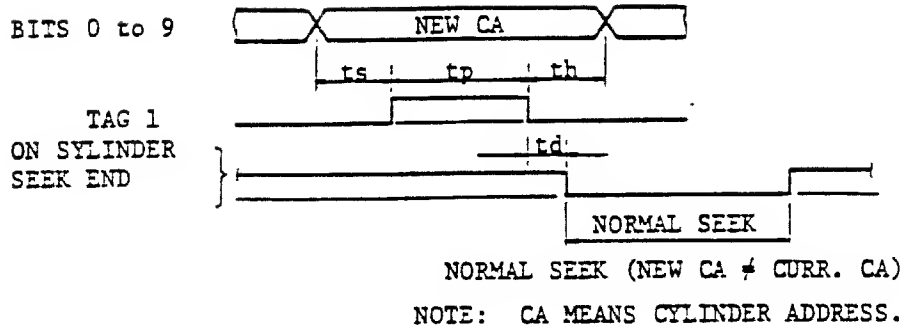
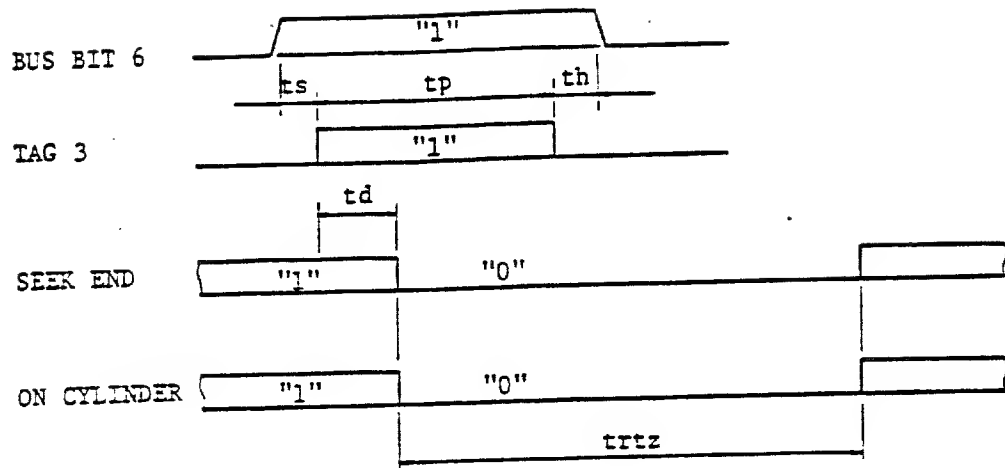
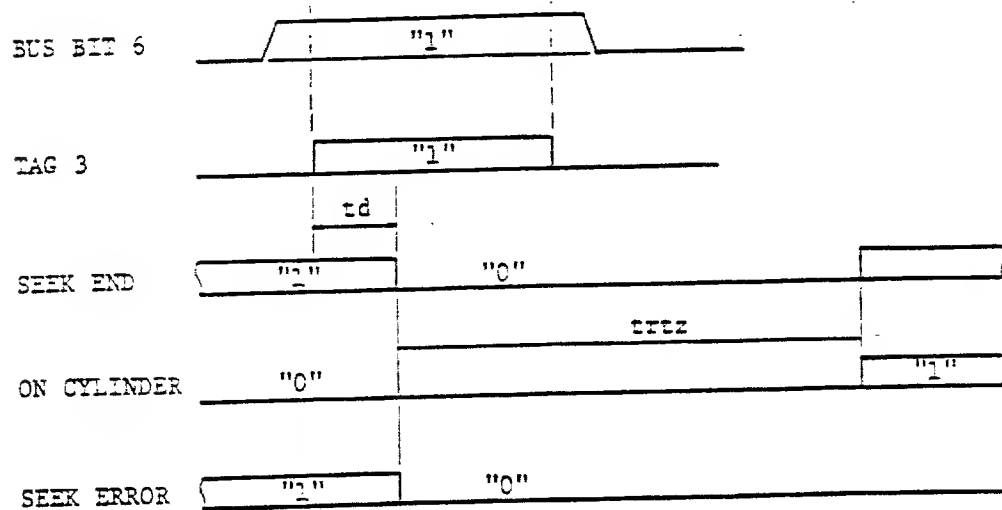


Figure 6-8 On Cylinder Timing



(a) NORMAL RTZ



(b) RTZ FOR SEEK ERROR

$$\begin{aligned}
 1 \text{ ms} &> & t_p &\geq 100 \text{ ns} \\
 && t_s, t_h &\geq 0 \text{ ns} \\
 && t_d &\leq 200 \text{ ns} \\
 && trtz &\leq 2 \text{ sec}
 \end{aligned}$$

Figure 6-9 Return to Zero Timing

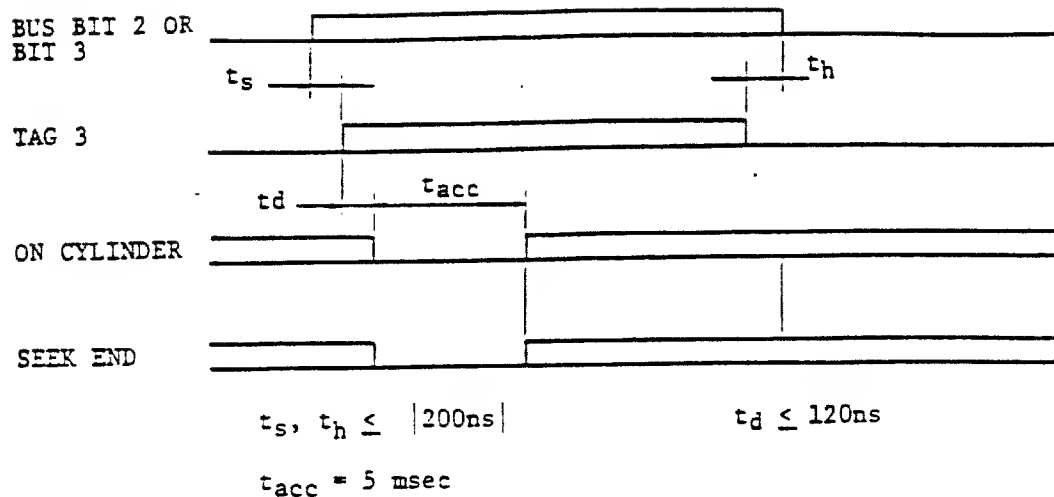
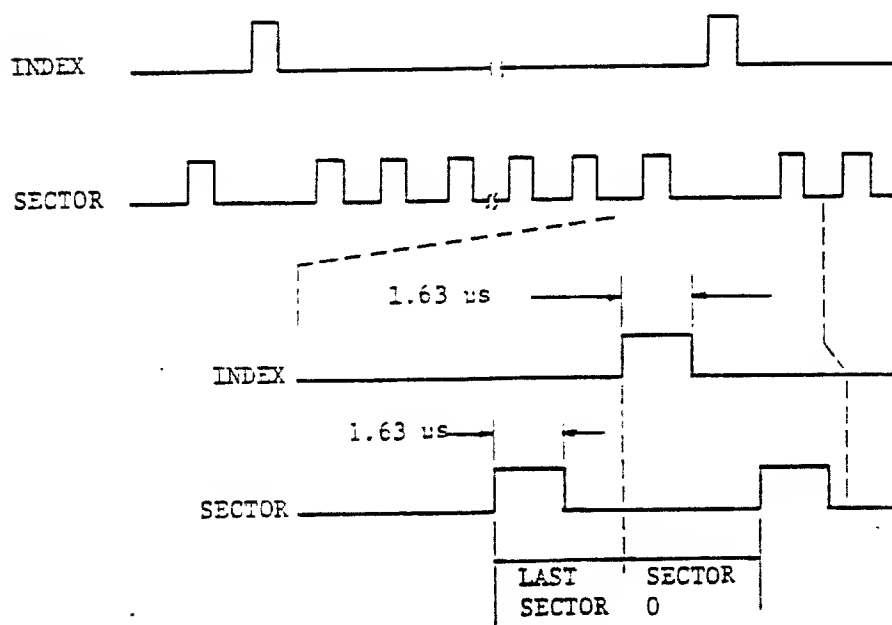


Figure 6-10 SERVO OFFSET "+", & "-" Timing



NOTE: TIMING SHOWN IS AT INPUT TO INTERFACE CABLE CONNECTOR OF DRIVE.

Figure 6-11 Index/Sector Timing

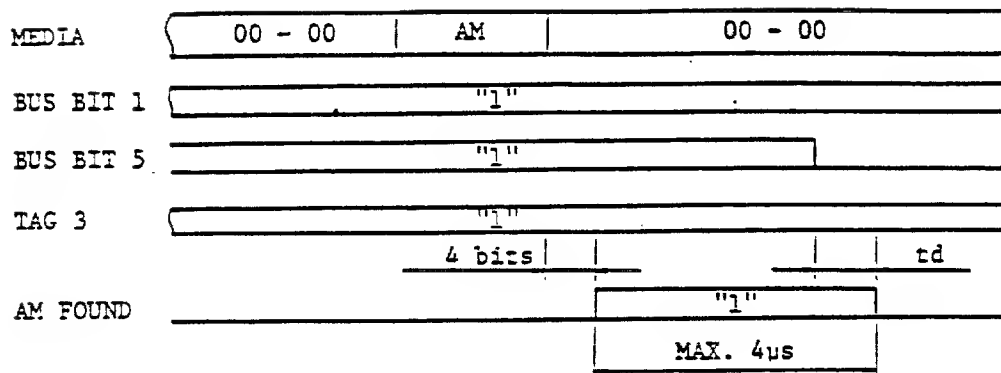


Figure 6-12 AM-FOUND Timing

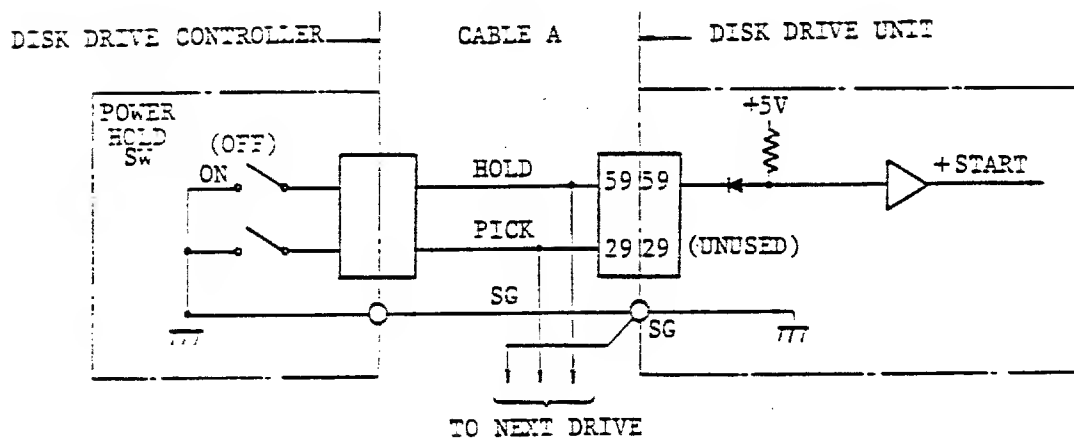


Figure 6-13 Spindle Motor Power Sequencing Control

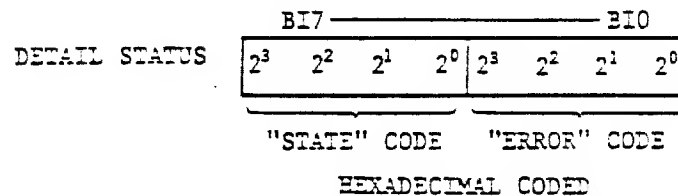
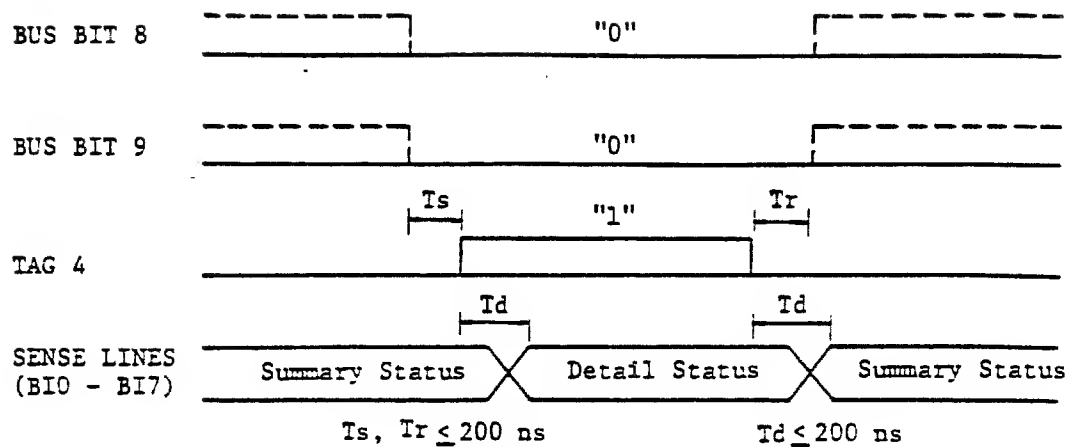


Figure 6-14 Read Detail Status Timing

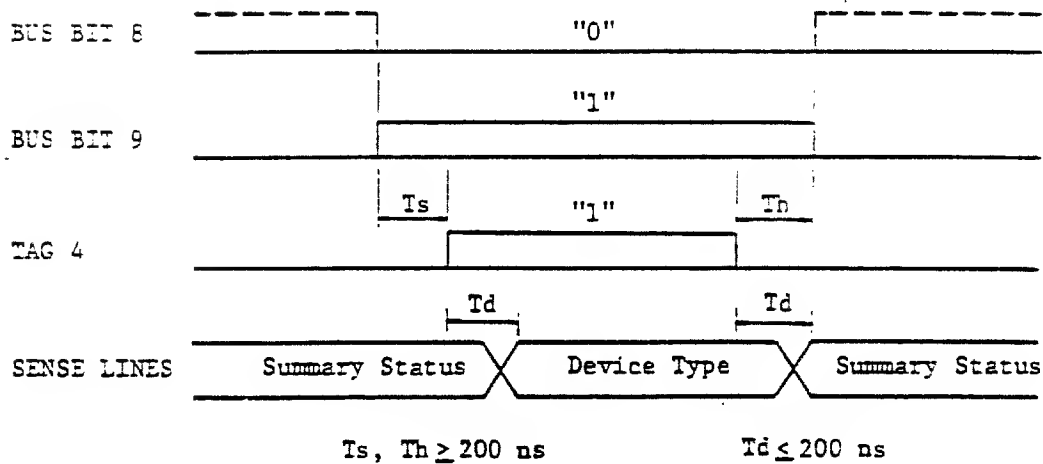
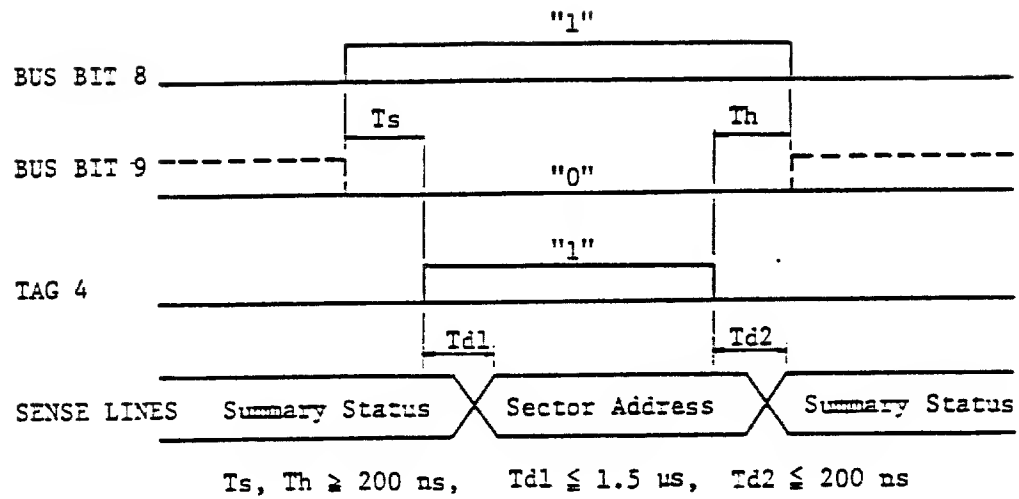


Figure 6-15 Device Type Request



#### EXAMPLE

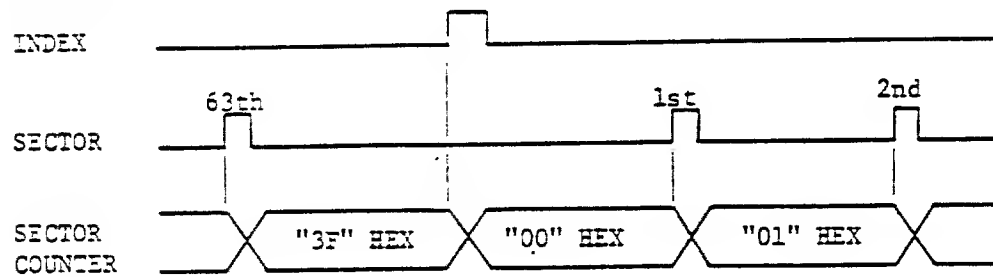


Figure 6-16 Read Sector Timing

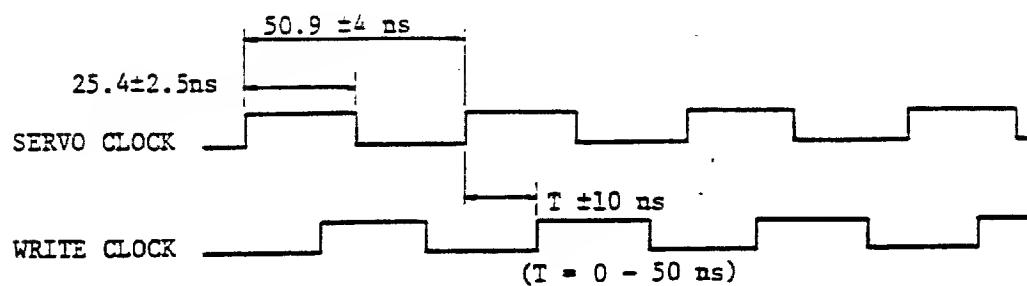
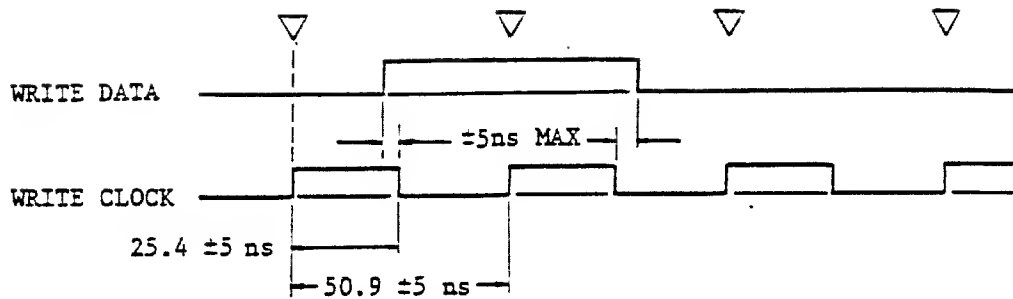


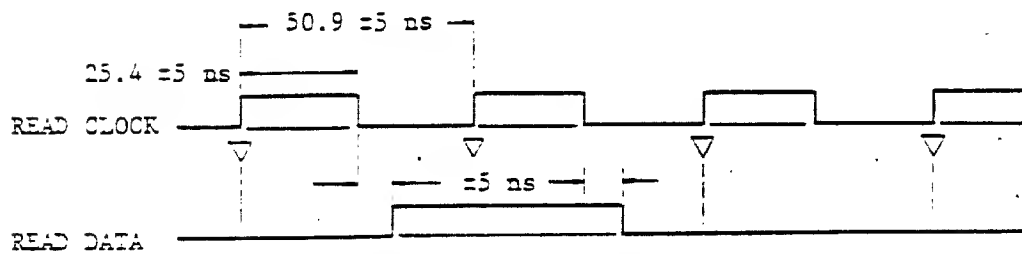
Figure 6-17 Servo Clock versus Write Clock



WRITE DATA VERSUS WRITE CLOCK

NOTE: INCLUDES ROTATING SPEED VARIATION AND PLO JITTER.

Figure 6-18 Write Operation Timing



NOTE: INCLUDES ROTATING SPEED VARIATION AND PLO JITTER.

Figure 6-19 Read Operation Timing



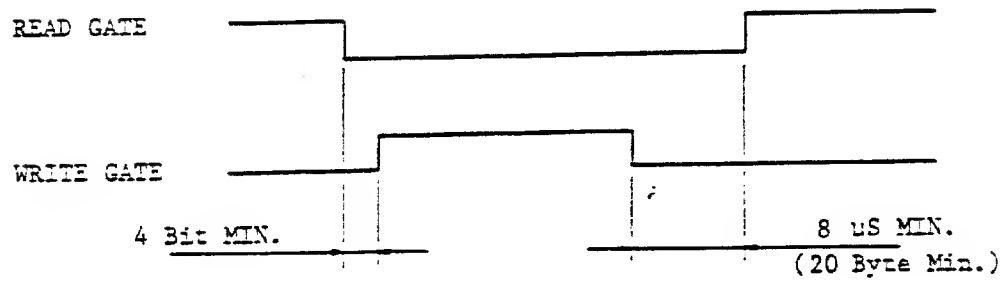
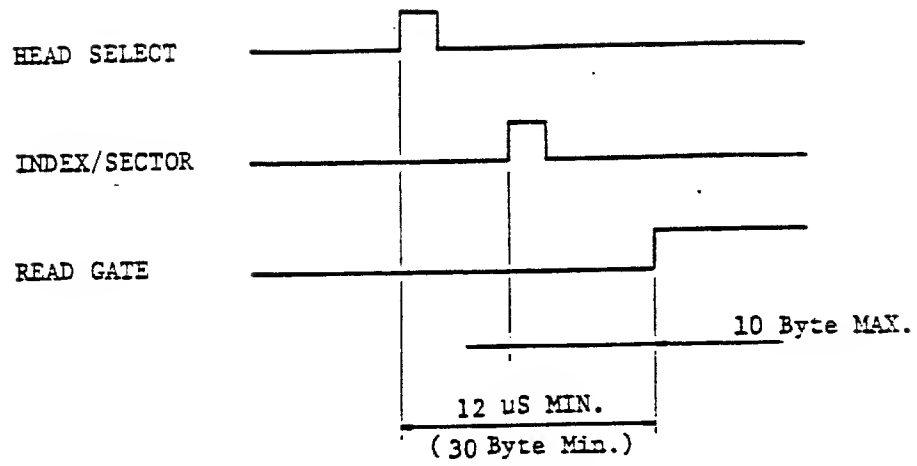


Figure 6-20 R/W Timing

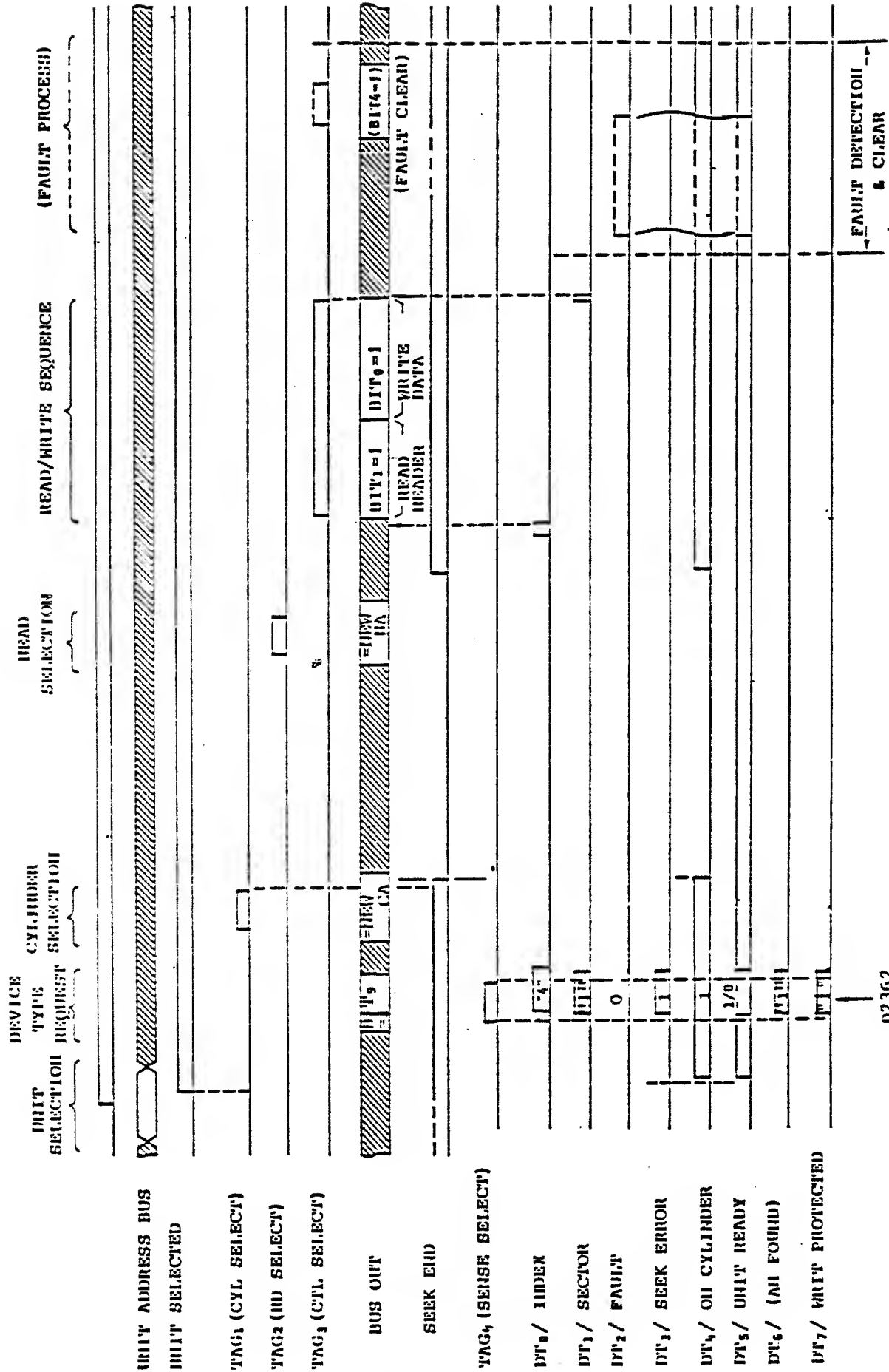


Figure 6-21 Interface Dialog

## CHAPTER 7

### DATA FORMAT

#### 7.1 FIXED-SECTOR FORMAT (Refer to Figure. 7-1)

The data format recorded on the disk drive is supervised by the controller. The Index and Sector pulses (see Figure 6-11) indicate the beginning of a track or sector to the controller. The various bytes in the data format must be counted with reference to the leading edge of the index or Sector pulse. The recommended Fixed Sector format and Variable Sector format will be described in this section.

#### 7.2 VARIABLE SECTOR FORMAT (Refer to Figure. 7-2)

When the variable sector format is used, an address mark of three byte erased area without any flux reversal must be written prior to the beginning of each record on a data track.

The address Mark Enable signal is used to generate and detect the address mark. The address mark is recorded on the data track while the AM Enable is issued from the controller during a write operation. In a read operation, the AM Enable is used to search for the address mark. When detecting the address mark, the AM Found signal is issued to the controller while the AM Enable is active.

For Variable sector operation, the AM-Enable pre-set switch shall be set to "Enable" position.

#### 7.3 CONTROL TIMING

The required control timing for R/W operations is shown in Figures 7-3 through 7-6.

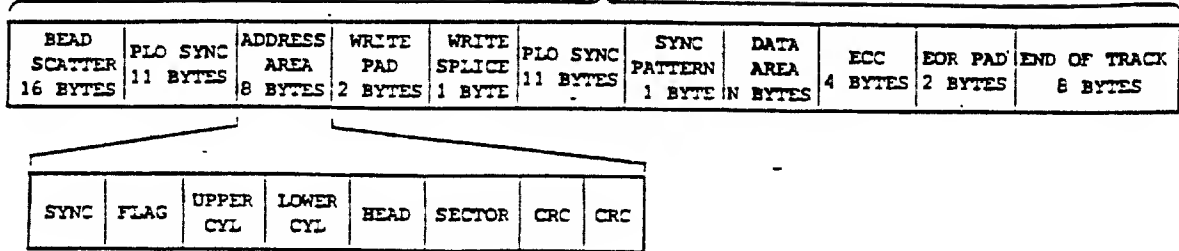
#### 7.4 INITIALIZE FORMAT

The drive is formatted at the factory with Standard Media Defect Format (so called "External Format") Prior to shipment. Refer to paragraph 2.6.4 for the detail.

INDEX/SECTOR

N IDENTICAL SECTOR

INDEX/SECTOR



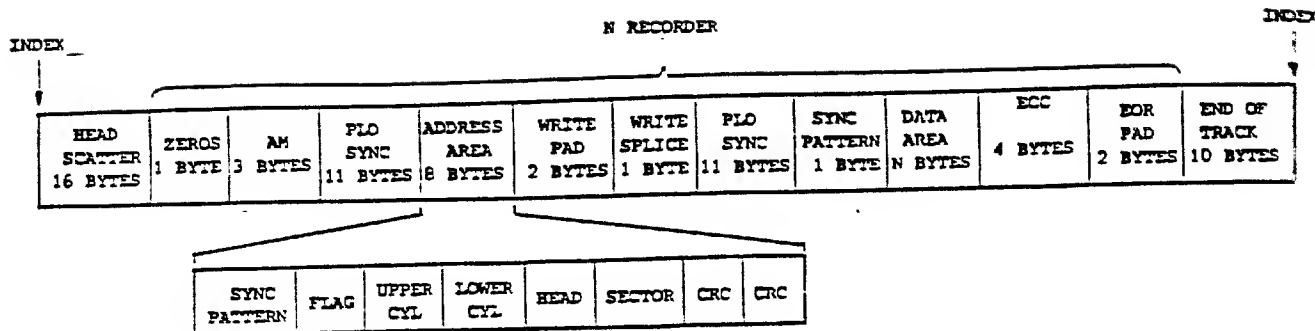
$$\text{Data Area} = \frac{\text{Total Byte/Track}}{\text{Sector/Track}} - (\text{SYNC FIELDS, TOLERANCE GAPS, AND ADDRESS})$$

Example: 40960 Bytes/Track

	UNFORMAT BYTES PER SECTOR	- NON-DATA	= DATA AREA	Ref
128 Sectors/Track	40960 128 (=320)	- 64	= 256	LENGTH OF END OF TRACK 8 BYTES

- NOTES: 1) This format is an example only and may be structured to suit individual customer requirements.
- 2) Any kind of SYNC byte patterns for address and data areas are available. Recommended SYNC Pattern = (19)HEX.
- 3) Data patterns for "HEAD SCATTER", "PLO SYNC", "WRITE SPICE", "EOR PAD" and "END OF TRACK" are all "0".
- 4) Fixed sectors per track may be any number from 1 through 128 and can be selected by setting the sector number selecting switches on the PWA.

Figure 7-1 Fixed Sector Format

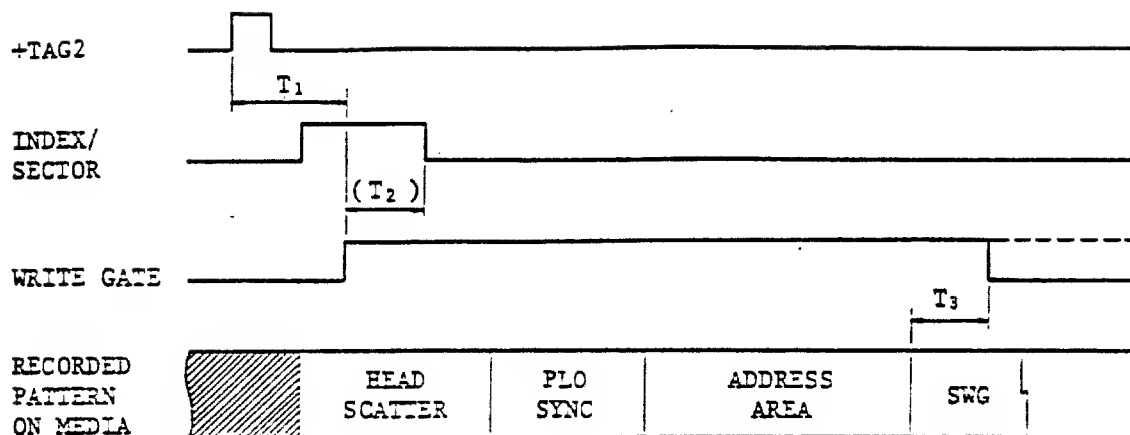


$$\text{Data Area} = \frac{\text{Total Bytes/Track} - \text{Index Loss}}{\text{Records/Track}} - (\text{Sync and Address Area})$$

40960 BYTES TRACK	Ex.1 128 Sectors/Track  Data Area = $\frac{40960-26}{128} - 41 = 278$ Data Bytes/ Sector
	Ex.2 256 Data Bytes/Sector  N Records = $\frac{40960-26}{256+41} = 137$ Sectors/Track

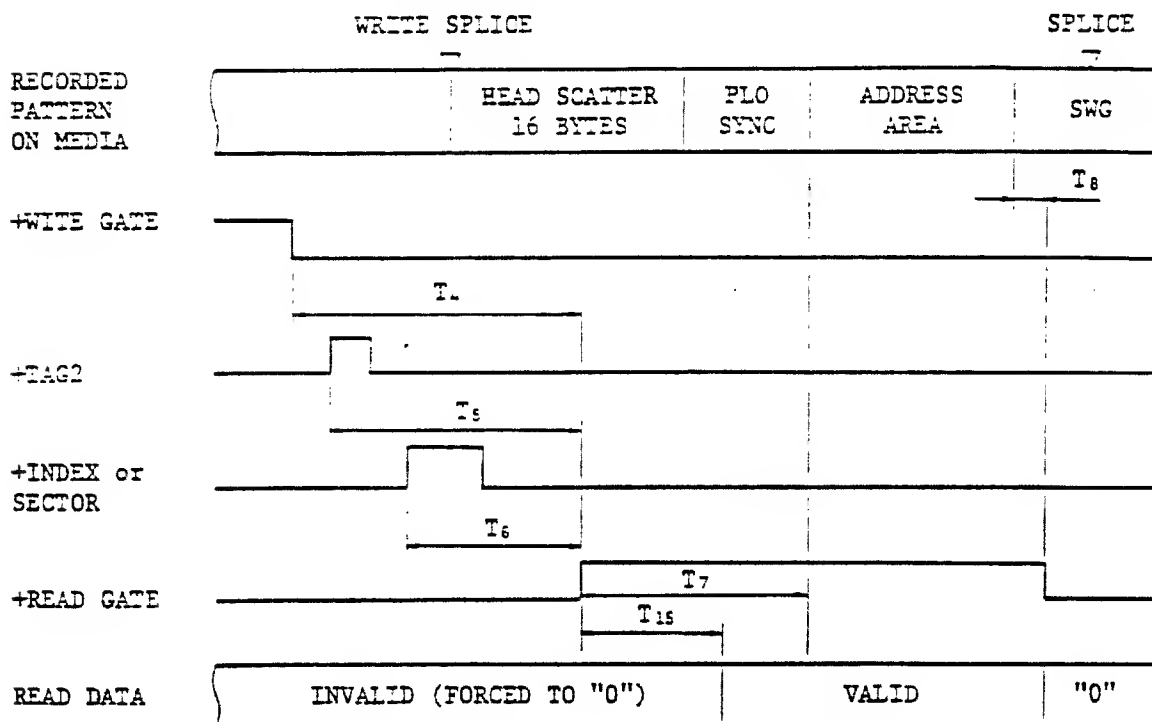
NOTE: This format is an example only and may be structured to suit individual customer requirements.

Figure 7-2 Variable Sector Format



$T_1$  : 1  $\mu$ s Min.  
 $(T_2$  : 1  $\mu$ s Max.)  
 $T_3$  : 2 Byte Min.

Figure 7-3 Write Format



$T_4$  : 8  $\mu$ s Min.  
 $T_5$  : 12  $\mu$ s Min.  
 $T_6$  : 8 Bytes (half of the head scatter)  
 $T_7$  : 10 Bytes Min.  
 $T_8$  : 2 Byte Max.  
 $T_{15}$  : 52 to 54 Bits

Figure 7-4 Read Format

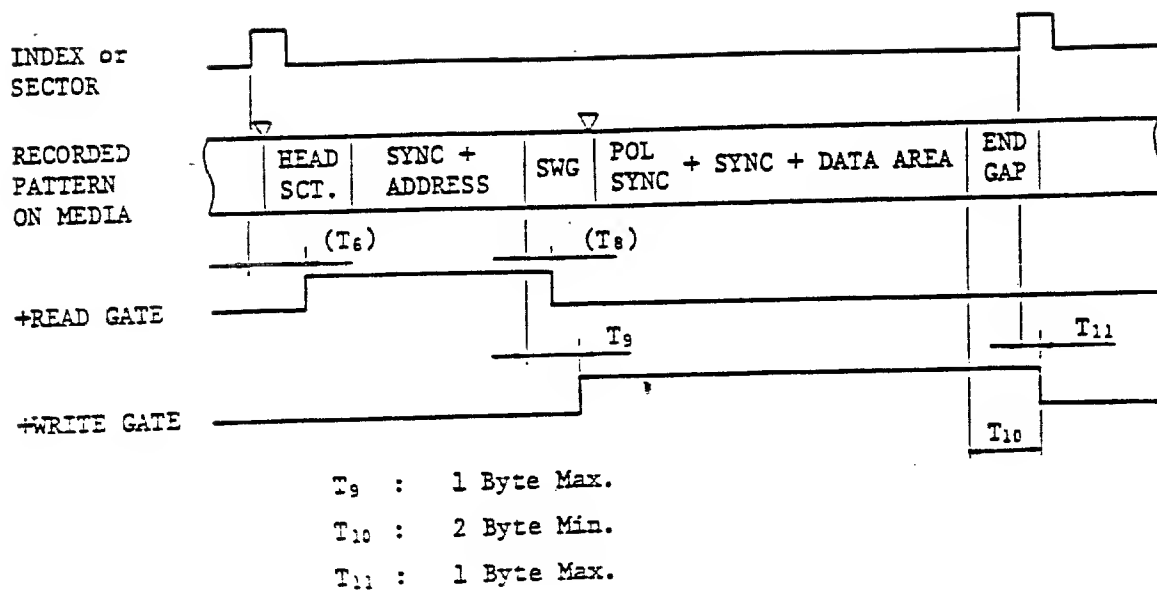
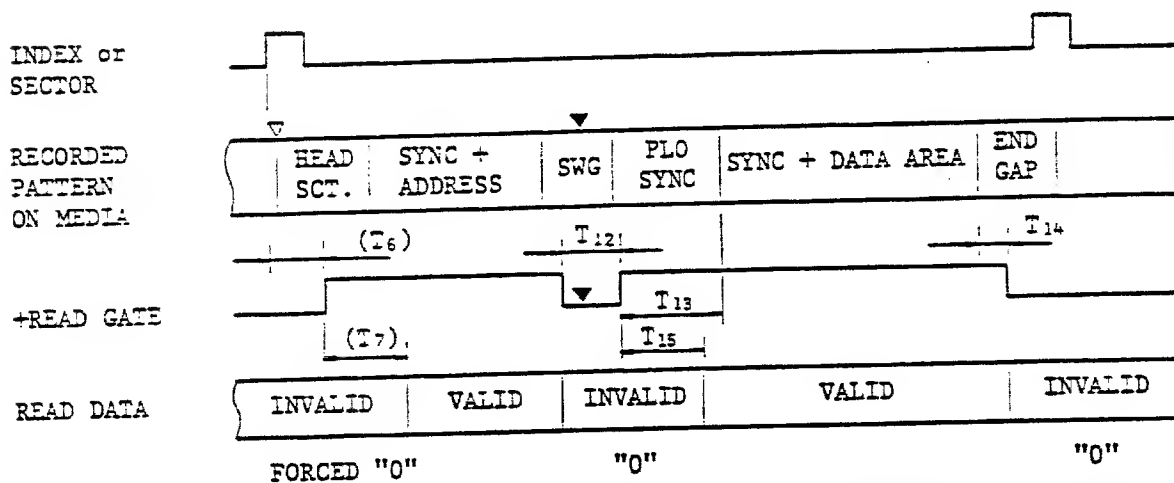


Figure 7-5 Write Data



Note 1: Forced all "0" pattern is sent back to controller during invalid read data.

T<sub>12</sub> : 1 Byte Min. (avoid write splice)  
 T<sub>13</sub> : 10 Bytes Min.  
 T<sub>14</sub> : 2 Byte  
 T<sub>15</sub> : 52 to 54 Bits

Figure 7-6 Read Data





## CHAPTER 8

### I/O CABLES AND CONNECTORS

The standard Cable A is 60-pin position configuration, and the standard Cable B is a 26-pin position configuration. Cable A is a twisted flat cable. Cable B is a ribbon-type flat cable with a ground plane and a drain wire. The physical and electrical characteristics of these cables help minimize cross talk and inductive coupling caused by discharges, as well as impedance variations, regardless of cable lay (routing and mounting).

#### 8.1 UNIT CABLING SYSTEM

The I/O cable connection between the controller and the disk drive uses daisy chain or radial connection (see Figure 1-4.)

##### 8.1.1 I/O Cable Characteristics

The I/O cable characteristics are shown in Table 8-1.

#### 8.2 I/O CONNECTORS

The I/O Connectors and Mating adapters are described in Table 8-2 and are shown in Figure 8-1.

#### 8.3 LOAD TERMINATORS

Cables A and B use line terminator resistors as load terminators at either or both ends of the cables to minimize signal reflections in the transmission cables between the controller and the disk drive.

##### 8.3.1 Cable A

Line terminator resistors are required at the transmitter and receiver end of each transmission line of Cable A. Terminator resistors are also required at the controller end of each line of Cable A except for the Open Cable Detect line. In addition, no terminator resistor is used on the power sequence lines of Cable A. A set of "On-Board Termination resistor" or an External Terminator module is available for the termination.

##### 8.3.2 Cable B

Terminator resistors are required on the receiving end of each Cable B transmission line. These resistors are at the disk drive receiver logic PWA.



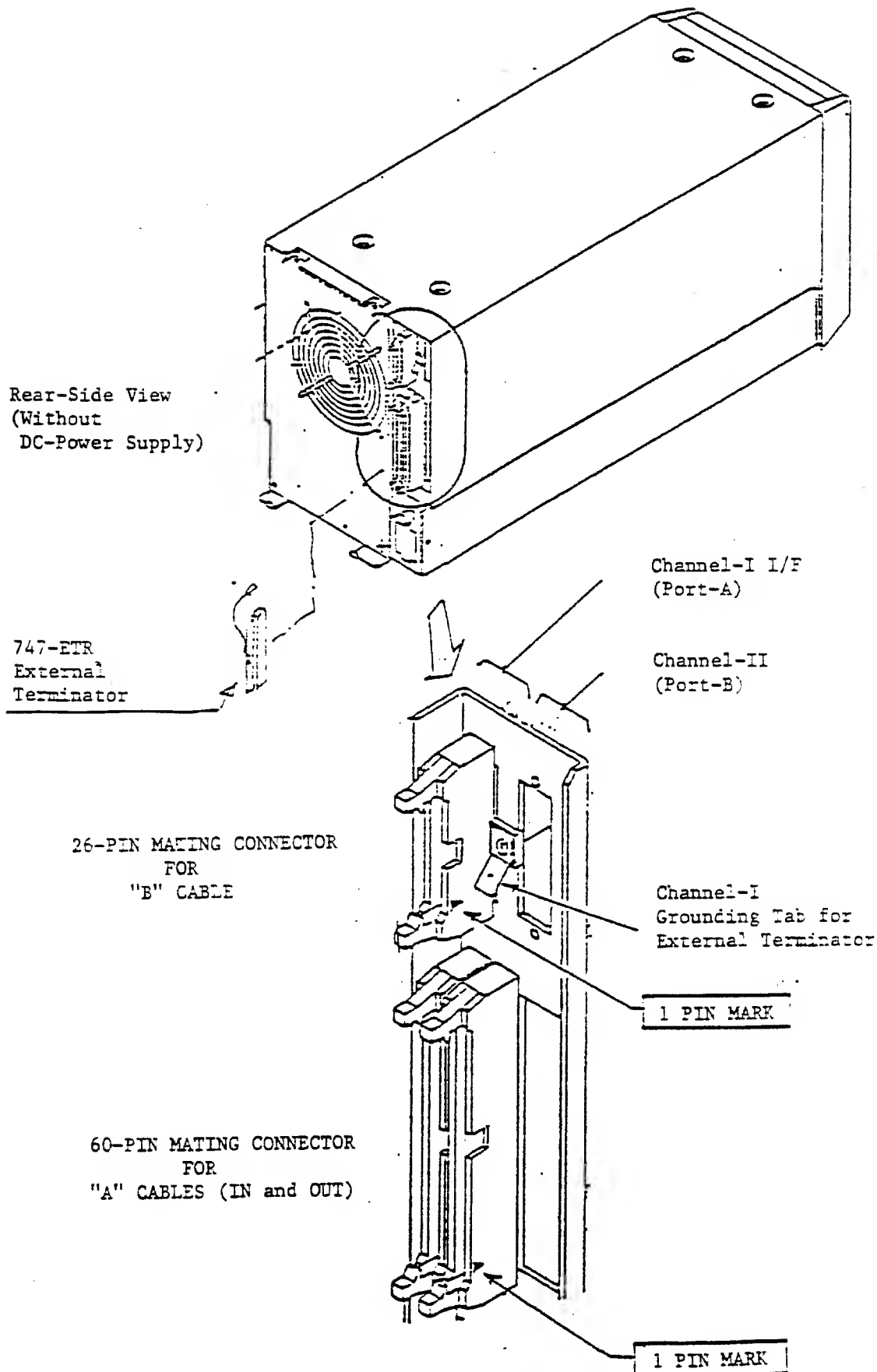


Figure 8-1 I/O Adapters

Table 8-1 I/O Cable Characteristics

FEATURE	CABLE A	CABLE B
Type	60 pin shielded, round-cable	26 pin shielded round-cable
Impedance	100 $\pm 10\Omega$	100 $\pm 10\Omega$
Wire Size	28 AWG,	28 AWG,
Propagation Delay Time	5.6 ns/m (nominal)	5.5 ns/m (nominal)
Maximum Cable Length	15 m	10 m
Voltage Rating	300 V rms	300 V rms
Part Number		

Table 8-2 I/O Connectors

CABLE	I/O CABLE ASSEMBLY	LOGIC PRINTED WIRING ASSEMBLY
A	60-pin connector 3 M #3334-6000 or equivalent	60-pin vertical adapter TPD #R60L NEC #802-710100-560 or equivalent
B	26-pin connector 3 M #3399-3000 or equivalent	26-pin vertical adapter TPD #R26L NEC #802-710100-526 or equivalent

Table 8-3 Terminators

CABLE	TERMINATOR
A	757-ETR EXTERNAL TERMINATOR (806-944644-001)



## APPENDIX A

### DUAL-PORT OPTION

#### A-1 SCOPE

This appendix describes the dual-port interface option for the D2362 disk drive. This document is written assuming the reader's familiarity with the operation of the dual-port option and, therefore, describes only the differences and features inherent to the dual-port interface. The reader is advised to reference the D2362 Product Description for greater detail of the basic drive functions.

#### A-2 GENERAL DESCRIPTION

The interface requirements of the dual-port drive (including line receivers, line transmitters, terminators, cable connectors, cabling, signal definitions, and pin assignments) are identical to those described in the Chapters before. The major difference is that the dual-port drive has a second interface, identical to the first, permitting the dual-port drive to communicate with two control units. The two identical interfaces are designated Port A and Port B, and with each communication pass is so called Route-0 (or Channel I) and Route-1 (or Channel II). Each port's physical interface to its attached control unit consists of an "A" (=control) cable and "B" (=Read/Write) cable. (See Figure A-1.)

(NOTE 1) EXTERNAL TERMINATOR ("On-Board Terminators also available)

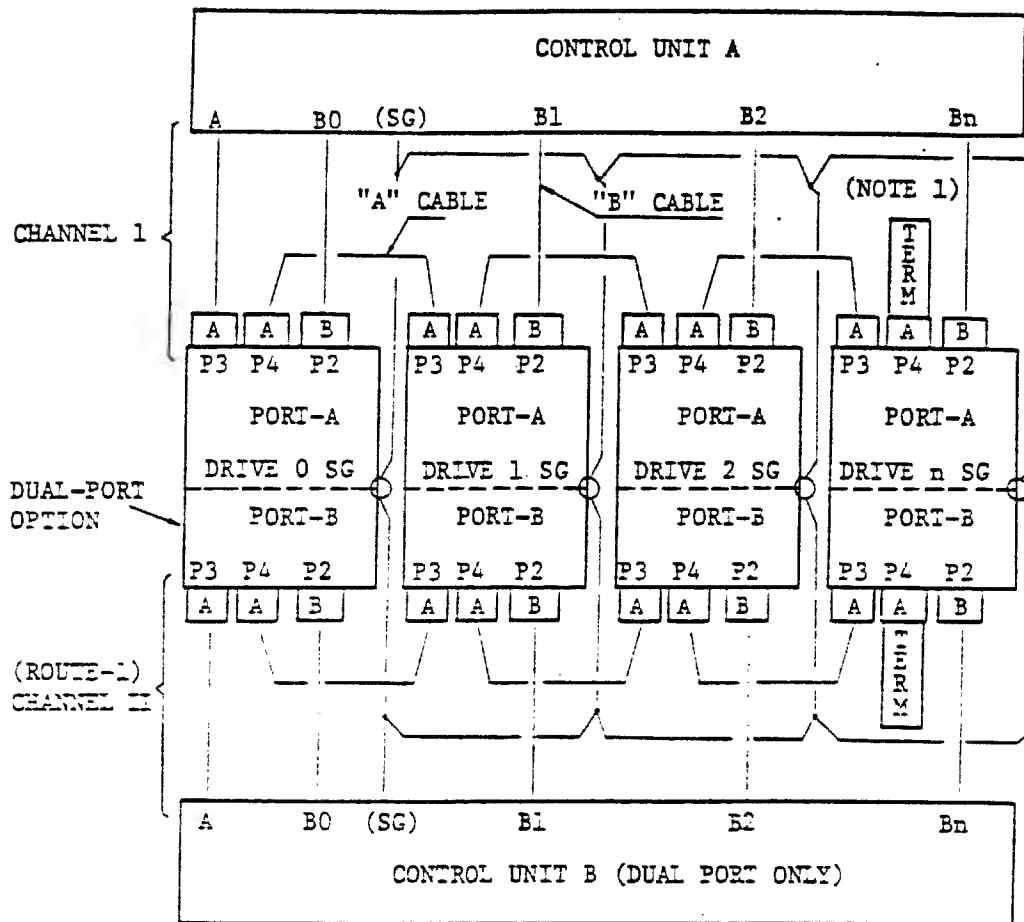


Figure A-1 System Interconnecting Cabling

### A-3 SWITCHES AND INDICATORS

The dual-port interface requires the following switches and indicators, located on the printed wiring assembly (PWA) of the dual-port option.

#### a) ROUTE-0 (PORT A) control Switch and Indicators

SWITCH "D" (=Disable) - This position disables the Device Selection from the ROUTE-0 control unit.

"E" (=Enable) - This position allows ROUTE-0 to be selected.

INDICATOR "RSV" - This LED indicates that the reserve latch is set to port A.

INDICATOR "SEL" - This LED indicates that the select latch is set to port A.

b) ROUTE-1 (PORT B) control Switch and Indicators

SWITCH "D" (=Disable) - This position disables the Device Selection from the ROUTE-1 control unit.

"E" (=Enable) - This position allows ROUTE-1 to be selected.

INDICATOR "RSV" - This LED indicates that the reserve latch is set to port B.

INDICATOR "SEL" - This LED indicates that the select latch is set to port B.

c) RELEASE TIMER ON/OFF Switch

"OFF" - This position inhibits the release timer, causing the drive to stay selected until specifically released by the operating control unit.

"ON" - This position enables the release timer to clear the reserve status 500 milliseconds (normal) following the last device selection. This allows alternate control unit access independent of the release command. The reserve timer will not clear a priority select.

A-4 PHYSICAL INTERFACE DESCRIPTION

The dual-port interface has two additional commands and one additional status line in the Control cable. The Read/Write cable has the same signals as the standard cable for the drive.

a) Release Command

This command (bus-out bit 9 and the control tag), transmitted to the drive, releases controller reserve and priority select in the drive, making alternate control unit access possible.

b) Priority Select

This signal is active when bus-out bit 9 is active coincident with the leading edge of the Unit Select signal and the desired logic number on the unit select number lines.

Setting priority select forces the drive to become unconditionally selected and absolutely reserved by the issuing control unit if the ROUTE 0/1 switch is in "E" (Enable) and the partner control unit does not have a priority select active. If the opposite control unit does not have an active priority select, but does have a select active, any operation is immediately terminated and the control unit force-released. This function enables a control unit to force a partner control unit and system off the drive in cases of urgency or suspected malfunction.

c) Busy Status

If the drive is selected and/or reserved by one control unit, the Busy Signals is active on the Control cable and the Selected signal is active on the Read/Write cable to the partner control unit attempting the select. These signals are issued from the drive within 600 nanoseconds following receipt of the selection attempt, and remain at this status until Unit Select is dropped or the drive is no longer busy.

## A-5 OPERATIONAL DESCRIPTION

The dual-port interface allows access to one drive by two control units. In allowing this dual access, the dual-port interface functions as a switch which routes necessary control and data signals to and from the correct control unit. Once the selection is made, the dual-port interface is essentially transparent. In addition to providing the required signal switching, the interface provides a special status response (Busy) to a control unit attempting to select a drive that is already selected and/or reserved by the partner control unit.

a) Drive Selection (See Figure A-2)

The switching necessary in the dual-port interface can be done by the LOGIC switch designed in the interface. For the LOGIC switch to be enabled, ROUTE 0/1 switch must be in the "E". When no control unit has the drive reserved, the LOGIC switch is in the NEUTRAL position. The drive may be selected and reserved from either port. The logic automatically latches to the first port to successfully complete a selection of the drive.

Drive selection is done by the selecting control unit setting the appropriate unit select number lines and setting the select enable 200 nanoseconds later. The dual-port interface enables the desired drive's number into the address comparison circuitry. If the unit select number and the unit address number are the same, and the drive is not reserved, the drive is selected 600 nanoseconds (maximum) after the leading edge of the Select Enable signal. This action automatically forces the drive to be reserved to the selecting port. This reserve status will not be cancelled until a release command, release timer timeout, or DC power-down/power-up occurs.

If the drive is already reserved and/or selected, an active Busy signal is issued on the Control cable of the controller attempting the select. This Busy signal is issued to the appropriate I/O connector within 60 nanoseconds after the selection attempt, and remains until the select enable line is deactivated, or the unit is no longer busy. Each control unit must monitor two lines during a select attempt.



(1) Selected

When active, indicates the control unit has successfully selected the drive, or the other control unit has the drive selected/reserved. When not active, indicates an address compare was successful.

(2) Busy

When active, indicates the partner control unit has the drive reserved/selected.

NOTE

When busy is active, all other transmitters in the Control cable are in the inhibit mode. Therefore, the receivers in the controller must be biased off to prevent incorrect status.

b) Priority Select (See Figure A-3)

Priority Select is a command from the control unit used to 1) force the release of a drive from the partner control unit, and/or 2) prevent the partner control unit from selecting the drive until the holding control unit issues a release. This command is activated by setting bus-out bit 9, the unit select number lines, and the select enable line. The dual-port logic examines bus-out bit 9 with the setting of select enable and, when it is active, attempts a priority select. The priority select attempt is successful only when the partner control unit does not have an active priority select. When the priority select is successful, the drive will 1) terminate the reservation and operation (if any) of the partner control unit; 2) set the Busy status line to the partner control unit (if selected); 3) become selected and reserved to the control unit initiating the priority select; 4) set the appropriate selected signal within 600 nanoseconds (maximum) of the Select Enable signal; 5) establish an internal priority select condition that prevents the drive from being reserved by the partner control unit until the selected control unit issues a release command.

c) Release

(1) Normal Release

A normal release of the drive is initiated by the control unit that has the drive reserved and selected. The release command must be active for 0.1 microsecond (minimum), and release reservation of the drive, independent of the release timer feature.

NOTE

Release command must be issued while the drive is selected.

(2) RELEASE Timer Release

The timer clears the reserve status 500 milliseconds (nominal) following the last selection. The reserve timer will not clear a port that has a priority select reserve.

d) Seek End Handling

(1) Normal

Seek end normally indicates the completion of any carriage motion operation, including seek incomplete.

NOTE

Seek end is sent to both ports if the drive is not selected. Otherwise, seek end is returned only to the selected port.

(2) Interrupt

The interrupt feature of the dual-port logic affects the Seek End signal meanings as follows.

- (a) If neither port is selected/reserved, the state of the Seek End signal is sent to both control units.
- (b) When the drive is reserved by one control unit, the normal Seek End signal is sent to the control unit. The nonreserved control unit will not see any state change in the Seek End signal during this time.
- (c) If control unit B attempts to select the drive while control unit A has it reserved, the logic will store this information and, when control unit A releases the drive, the Seek End signal to control unit B will go low for 30 microseconds and then high. This low-to high transition informs control unit B the drive is now released.
- (d) If, while the drive is reserved by one control unit, the same signal, described in step (c), occurs to the partner control unit when the control unit releases the drive.

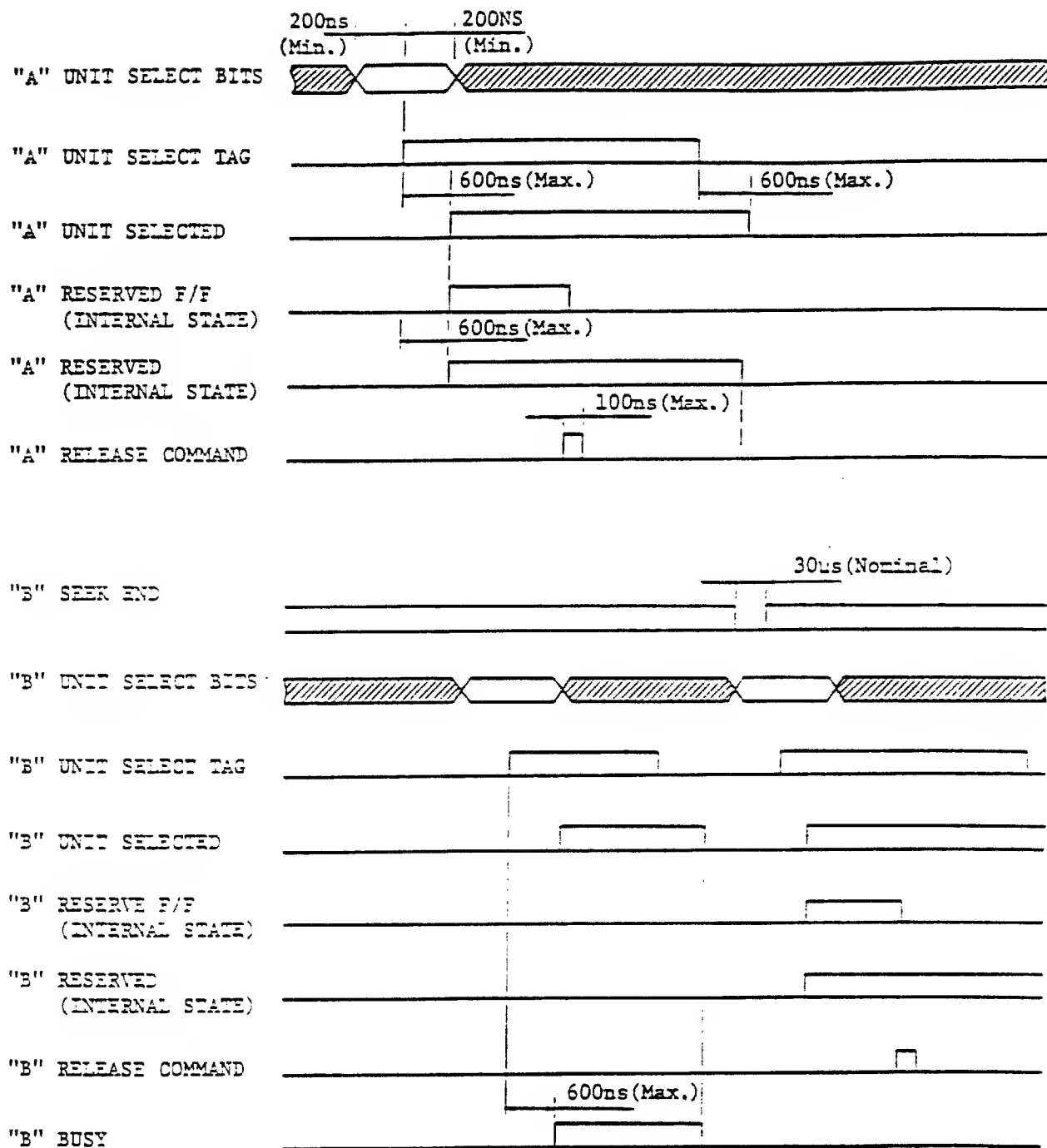


Figure A-2 Unit Select Timing for Dual-Port

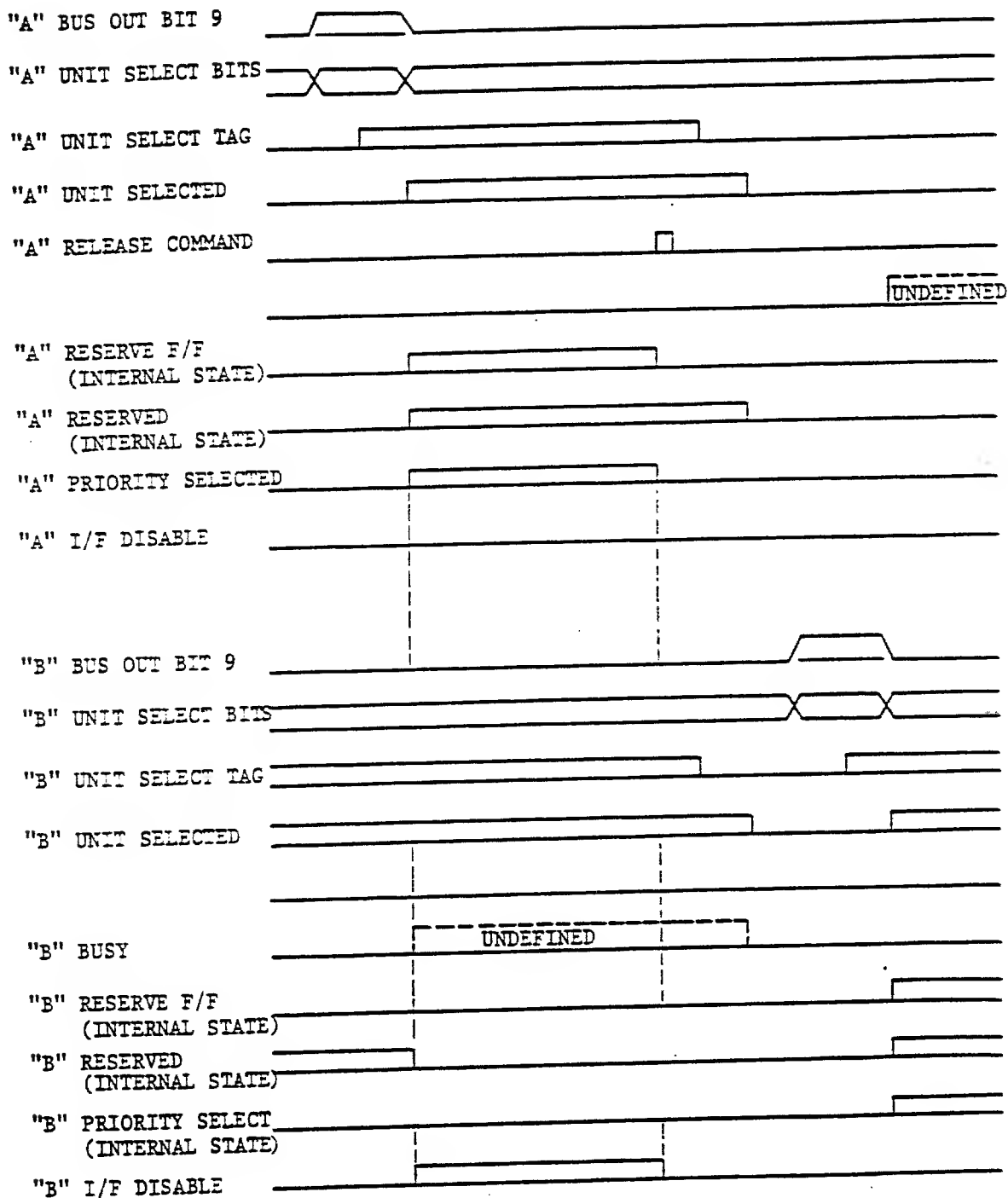


Figure A-3 Sample Priority Select Timing



## APPENDIX B

### 752 POWER SUPPLY

#### B-1 GENERAL DESCRIPTION

The 752 Power Supply receives its input from the cabinet AC power distributor, and uses it to produce the dc voltage necessary for drive operation.

The Power Supply operates at the following power source:

100 V - 120 Vac	} at 50/60 Hz
200 V - 240 Vac	

The voltage selector operates the change of input power voltage.

#### B-2 PHYSICAL SPECIFICATIONS

The dimensions of the 752 power supply are shown in Figure B-1.

#### B-3 BLOCK DIAGRAM

The Block Diagram is shown in Figure B-2.

#### B-4 POWER REQUIREMENTS

The ac power requirements with disk drive are shown in Table B-1.

#### B-5 ELECTRICAL SPECIFICATIONS

Table B-2 lists the electrical specifications of the power supply.

#### B-6 DC OUTPUT CONNECTOR

The AMP Connector with 15 pins (catalogue No. 1-480710-0) provides the disk drive with DC power. (See Figure B-3 & Table B-3.)

#### B-7 CIRCUITS

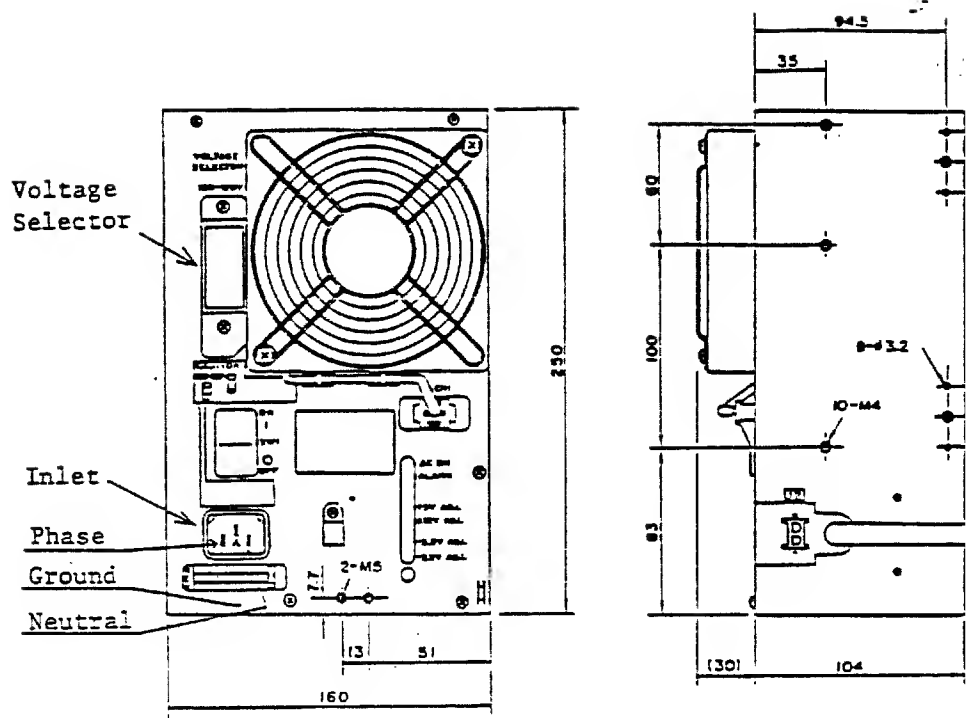


Figure B-1 752 Power Supply Dimensions

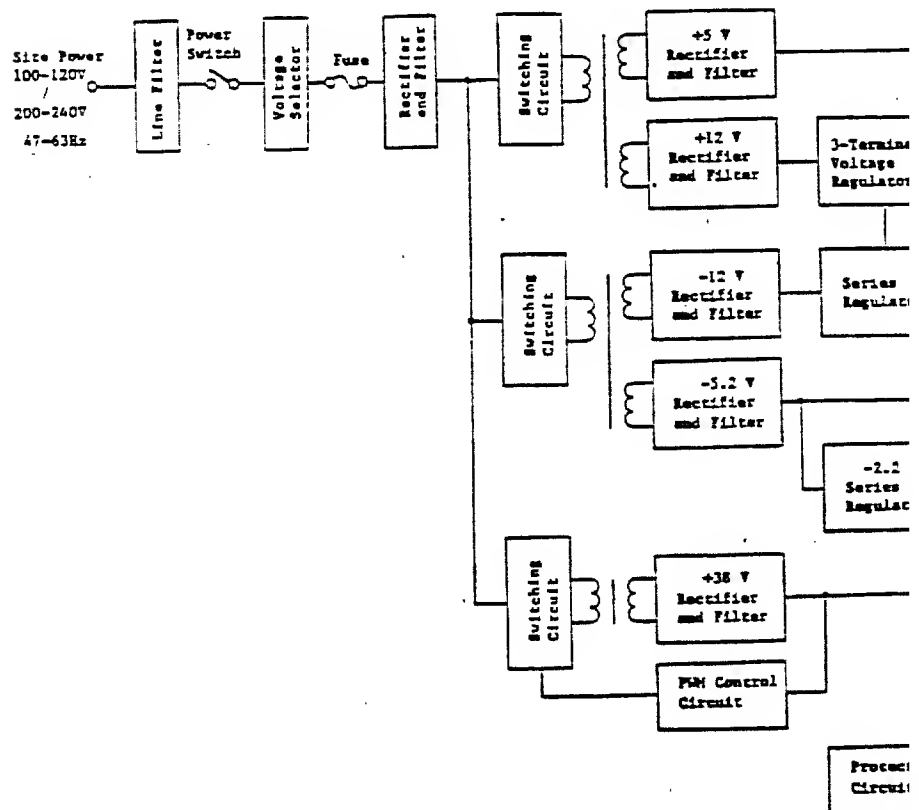


Figure B-2 Block Diagram



Table B-1 Power Requirements

Input Voltage	100 - 120 Vac Single Phase	200 - 240 Vac Single Phase
Voltage Range	90 to 132 V	180 to 264 V
Frequency Range	47 to 63 Hz	47 to 63 Hz
Power Consumption		
Start-up	500 W	500 W
* Operating	350 W	330 W
Line Current		
Start-up	6.0 Arms	4.0 Arms
* Operating	4.0 Arms	2.6 Arms

\* When disks are rotating and carriage is moving.

Table B-2 Electrical Specifications

Output Voltage (Volts-dc)	Regulation ( <u>±</u> Volts-dc)	Current (Amps-dc)	Ripple and Noise Maximum (millivolts p-p)
+5	0.25	2.5 to 8	100
+12	0.6	0.4 to 1.0	100
+38	3.8	0 to 5 (10A peak)	380
-2.2	0.11	0 to 2.5	100
-5.2	0.26	0.3 to 6	100
-12	0.6	0.4 to 1.0	100

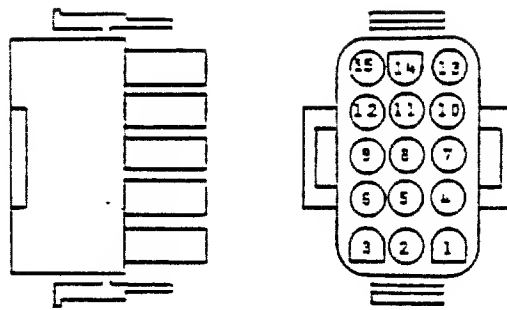


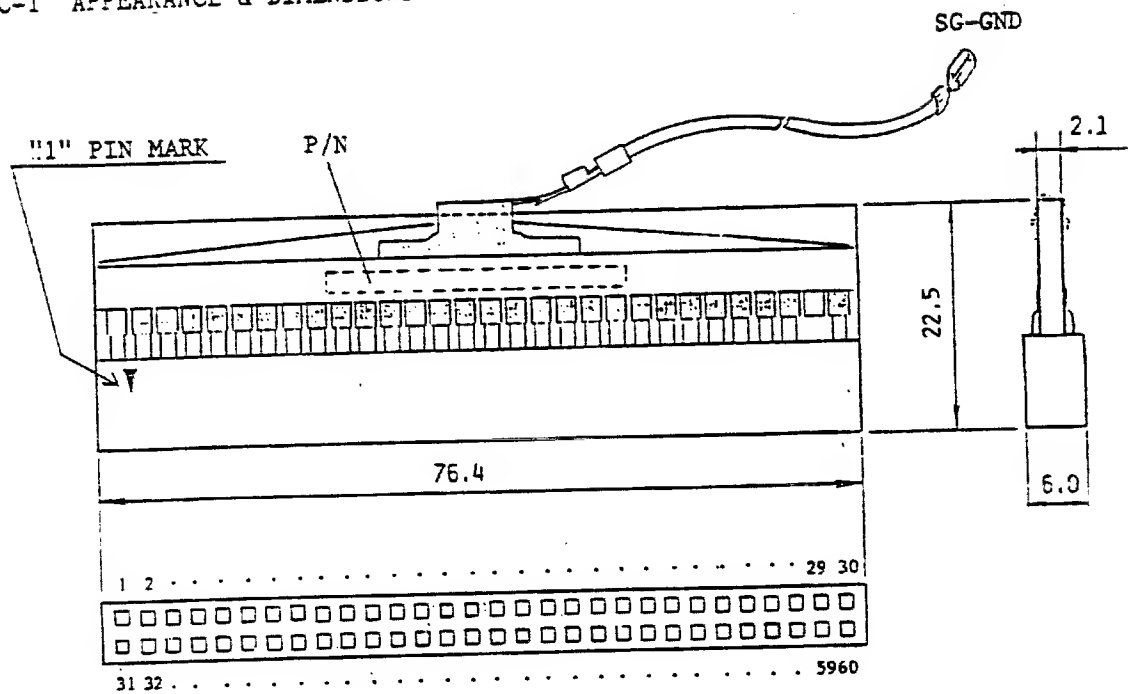
Figure B-3 DC Output Connector

Table B-3 Pin Assignment

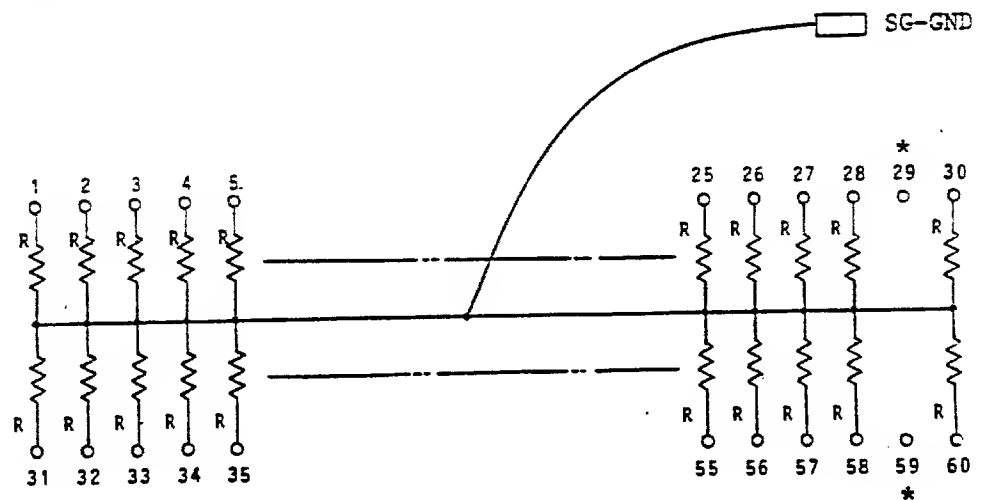
Pin Number	Function
1	+5V
2	GND
3	-5.2V
4	+5V
5	GND
6	-5.2V
7	+12V
8	GND
9	-12V
10	+38V
11	GND (38V RTN)
12	-2.2V
13	+38V
14	GND (38V RTN)
15	RESET (MAKE-GND)

# APPENDIX-C 747 EXTERNAL TERMINATOR

## C-1 APPEARANCE & DIMENSIONS



## C-2 CIRCUITS



\*NOTE : 29,59 PIN OPEN  
R = 56 ohms

.

## APPENDIX-D

### 752-FP FRONT PANEL

#### D-1 PREFACE

This appendix describes the 752-FP FRONT PANEL option for the Disk Drive.

#### D-2 APPEARANCE & DIMENSIONS

The appearance and dimensions of the 752-FP FRONT PANEL are shown in Figure D-1.

#### D-3 REFERENCE CIRCUIT DIAGRAM

The reference circuit diagram of the 752-FP FRONT PANEL is shown in Figure D-2.

#### D-4 SWITCH FUNCTIONS

##### (1) STOP/(START) switch (Alternate switch)

Closing the RTN (=signal ground) signal and this signal line causes the DKU to enter in the motor stop mode. When in the open status, this places the DKU in the start mode.

The condition for DKU start is obtained by logical product with the POWER HOLD (HOLD) signal function of the "A" cable of the DKC interface.

##### (2) FAULT CLEAR switch function (Momentary switch)

Closing the RTN signal and this signal line instructs the DKU to disengage the "FAULT" status.

##### (3) PROTECT/(PERMIT) switch (Alternate switch)

Closing the RTN signal and this signal line places the DKU in the write protected status. When open, write is enabled. The "PROTECT" status for DKU corresponds to this signal function.

##### (4) UNIT ADDRESS switch ( $2^0, 2^1, 2^2$ and $2^3$ ) (Rotary switch)

Total 4 bits ( $2^0, 2^1, 2^2$  and  $2^3$ ) lines are received as the UNIT ADDRESS (or also called DEVICE NUMBER) bits and each of them are connected to the corresponding switch bits (5,6,7,8) of the "SW2" as assigned as the internal UNIT ADDRESS switches which are described in the item(1) of paragraph 4.4.1 of D23xx 9-INCE WDD PRODUCT DESCRIPTION.

The UNIT ADDRESS of this Disk Drive can be displayed by the ADDRESS PLATE SET (attachment of this FRONT PANEL).

#### D-5 INDICATE FUNCTION OF 752-FP FRONT PANEL

The 752-FP FRONT PANEL has four light-emitted diodes (LED).

(1) READY indicator (Green LED)

The READY indicator lights when the DKU is in the ready status.

(2) START indicator (Yellow LED)

The START indicator is in the button of the STOP/(START) switch. This indicator lights when the STOP/(START) switch is set to the start.

(3) FAULT indicator (Red LED)

The FAULT indicator is in the button of the FAULT CLEAR switch. This indicator lights when a fault occurs in the DKU.

(4) PROTECT indicator (Yellow LED)

The PROTECT indicator is in the button of the PROTECT/(PERMIT) switch. This indicator lights when the PROTECT switch is set to the write protect.

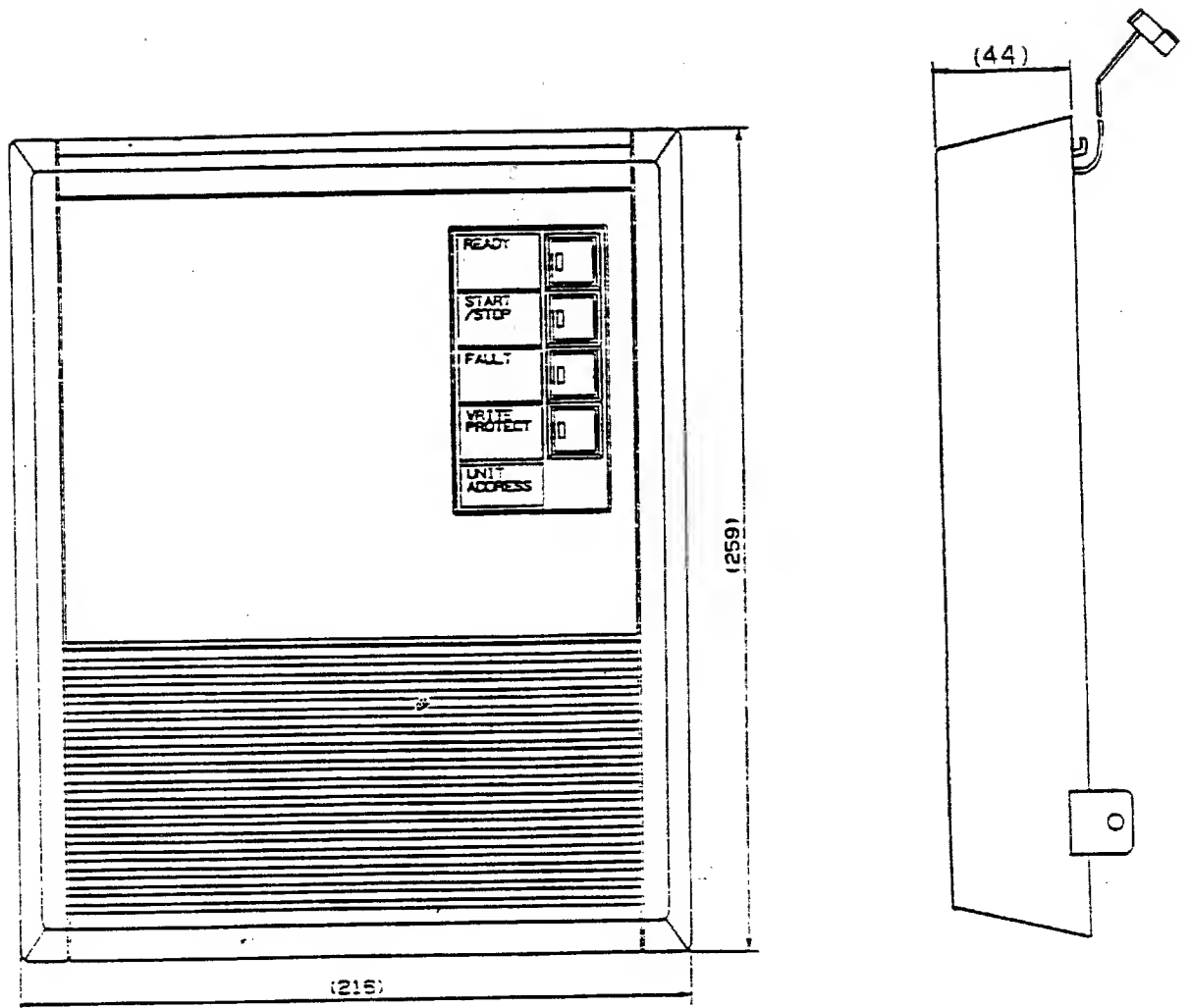
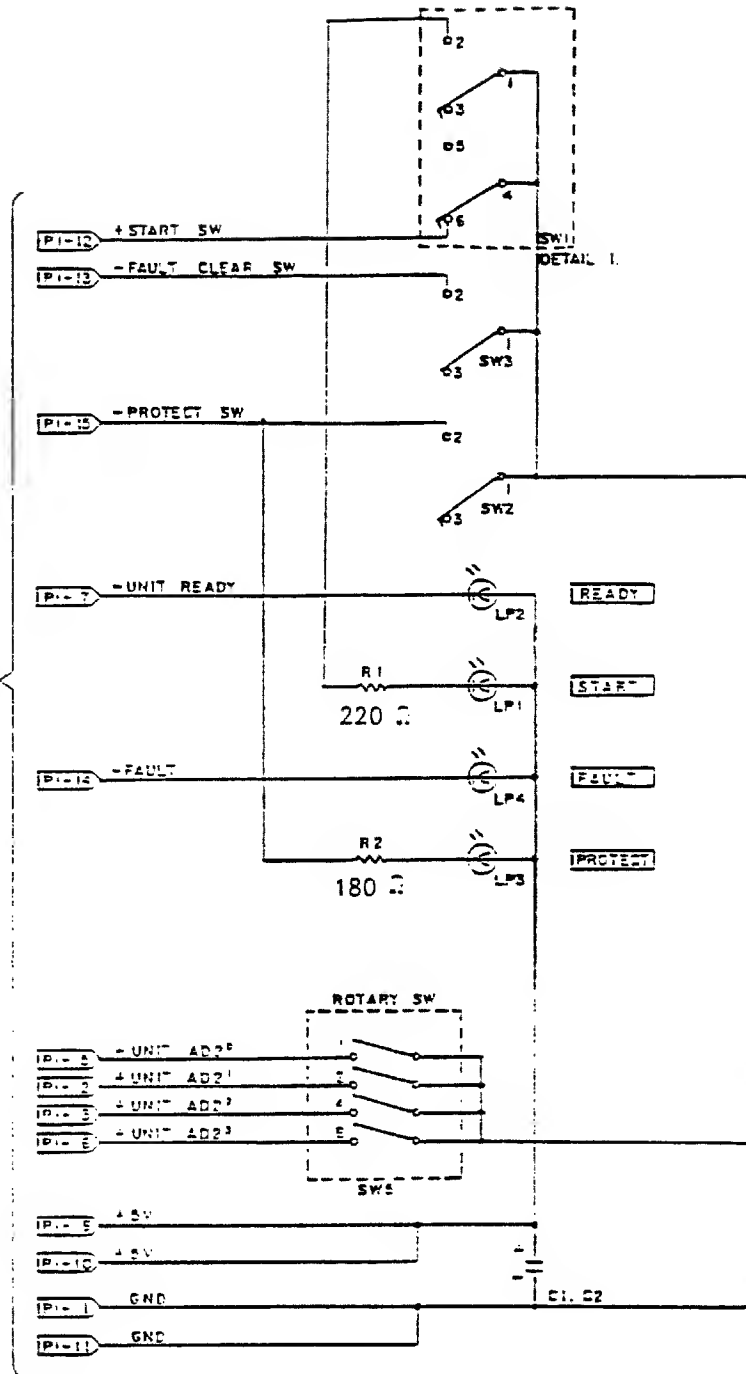


Figure D-1 Appearance and Dimensions

FROM  
"LOGIC & SERVO" PWA



DETAIL 1: SW1 is a Double - Pole - Double - Throw Switch.

Figure D-2 Reference Circuit Diagram



## APPENDIX-E

### SD231 STATUS DISPLAY

#### E-1 GENERAL

This Status Display functions as a status monitor for the disk drive.

#### E-2 LOCATION

The location of this Status Display in the disk drive is shown in Figure E-1. The cable for this Status Display is inserted in P59 on the "LOGIC & SERVO" PWA.

#### E-3 OPERATOR SIDE VIEW AND DISPLAY CODE

The sight of this Status Display from operator side is shown in Figure E-2 and its display code is shown in Table E-1.

#### E-4 SUMMARY OF THE FUNCTIONS OF SWITCHES AND DISPLAYS

This Status Display has two toggle switches (SW1, SW2), momentary switch (SW3) and two 7-segment displays. The toggle switch (SW2) is an Operation Mode Switch for selection of "NORMAL" or "EXTENDED" mode. The toggle switch (SW1) is a Status Mode Switch for selection of "STATUS" or "DIAGNOSTIC" mode. The momentary switch (SW3) is a Reset Switch which functions only with SW1. Two 7-segment displays indicate the drive statuses.

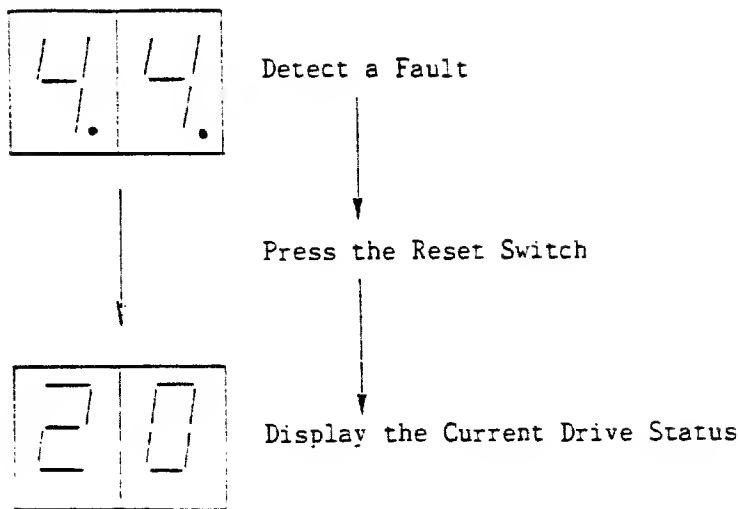
#### E-5 FUNCTION OF STATUS MODE SWITCH (SW1)

##### E-5.1 Status Mode

- (1) When the Status Mode Switch is preset to the "STATUS ONLY", the Status Display is selected to the status mode. During the online operation, the current status is indicated on the two 7-segment displays.

If any Fault or Seek Error is occurred, the information is displayed and the display is fixed, and decimal points in each display will turn on. When the Reset Switch (SW3) is pressed, the held error information will be reset and the indication will return to the current drive status display.

Shown below is an example.



- (2) The Display Codes of the disk drive during normal operation is shown in Table E-2.
- (3) Refer to Table 6-4 and 6-5 for details of Fault-Code and Seek Error-Code.

#### E-5.2 Diagnostic Mode

When the Status Mode Switch is preset to the "DIAGNOSTIC ENABLE", the Status Display is selected to the diagnostic mode. In this mode, the drive is switched to the CE mode and separated from the interface. Pressing the Reset Switch (SW3) causes a CE reset instruction to be given to the device.

#### E-6 FUNCTION OF OPERATOR MODE SWITCH (SW2)

##### E-6.1 Normal Mode

When the Operation Mode Switch is preset to the "NORMAL MODE", the Status Display is selected to normal mode. In normal mode, cylinder addresses "0" to "CA.MAX" are accessible.

##### E-6.2 Extended Mode

(TBD)

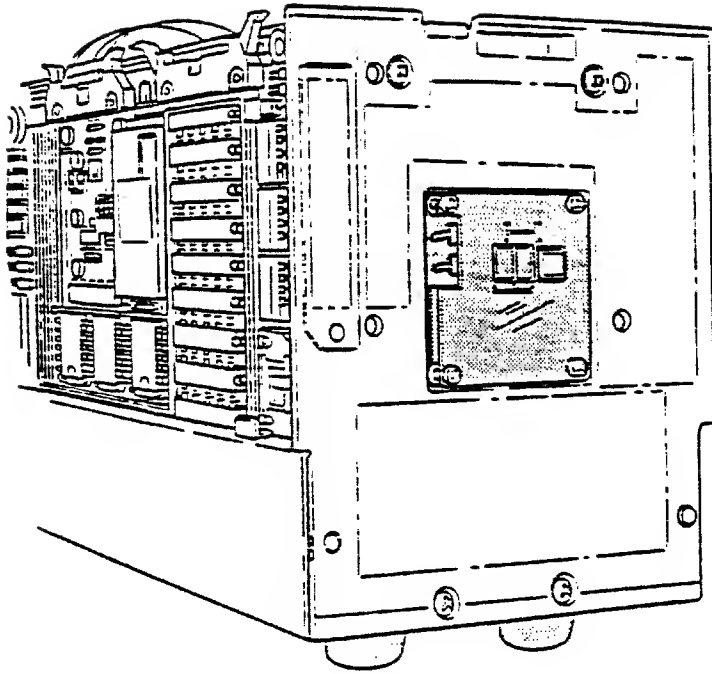


Figure E-1 Location of the Status Display

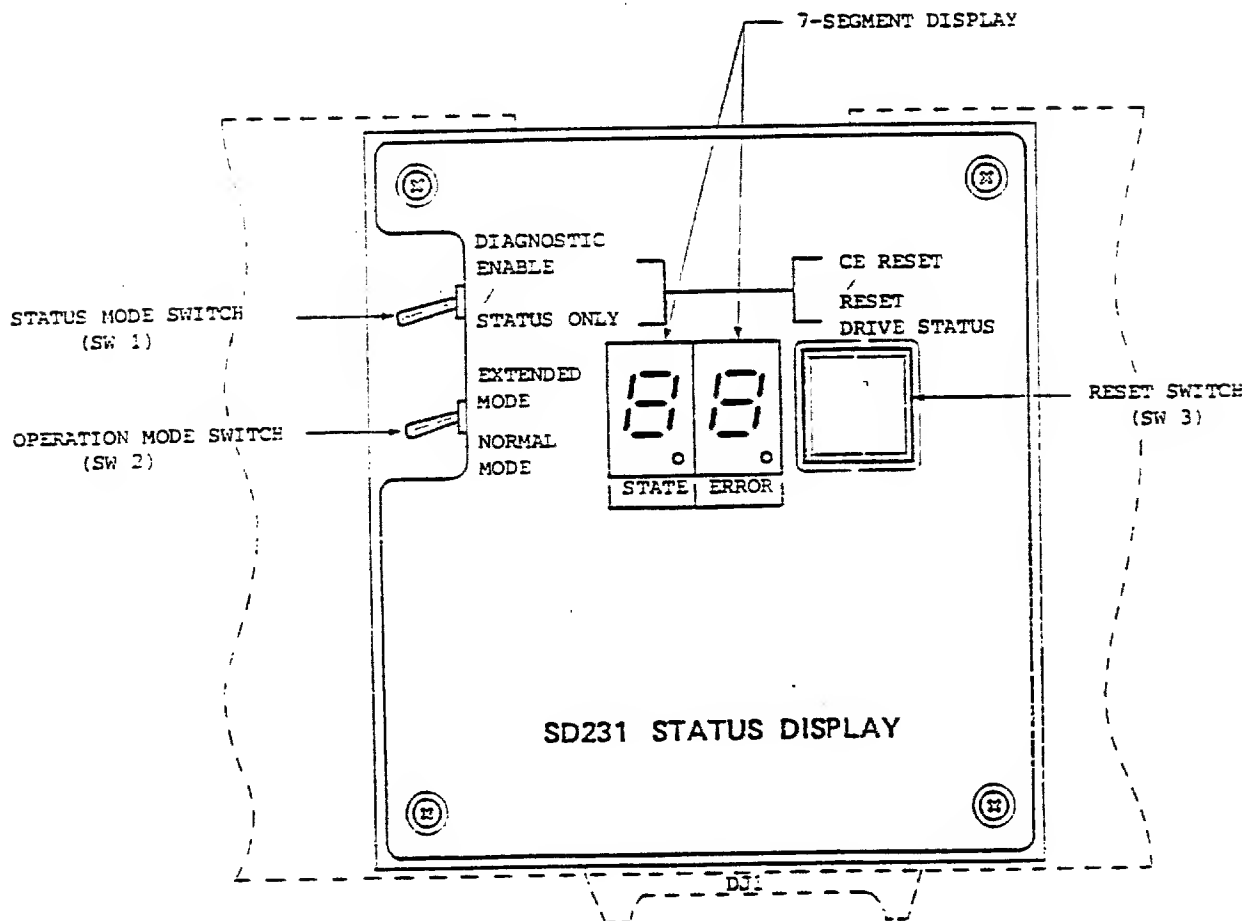


Figure E-2 Operator Side View of the Status Display

Table E-1 Display Code

















	0		8
	1		9
	2		A
	3		B
	4		C
	5		D
	6		E
	7		F

Table E-2 Display Codes in Normal Operation

DISPLAY CODE		STAGE DESCRIPTION
STATE	FAULT	
0	0	POWER ON RESET
1	0	POWER ON INITIALIZE
2	0	STOP
3	0	START WAIT
4	0	MOTOR START
5	0	MOTOR SPEED UP
6	0	MOTOR SPEED OK
7	0	LOCK SERVO PLO
8	0	RECALIBRATE OUT
9	0	RECALIBRATE IN
A	0	READY
B	0	MOVE OUT
D	0	MOVE IN

NOTE 1

NOTE 2

NOTE 3

NOTE 1 : To find these codes are almost impossible because of rapid sequence up. The display time of code "30" is dependent on the SW3-Motor Start Control on the "LOGIC & SERVO" PWA. (Refer to Figure 4-7 for details)

NOTE 2 : Sequence up time is 20~30 seconds.

NOTE 3 : To find these codes are almost impossible because of rapid sequence up.

1  
2  
3  
4  
5

USER'S COMMENTS FORM

Document:	D2362	9-Inch Winchester Disk Drive
	Product Description	
Document No.:	(806-520261-0)	

Please suggest improvements to this manual.

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Please list any error in this manual. Specify by page.

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From:

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

Date: \_\_\_\_\_





## APPENDIX B

### 752 POWER SUPPLY

#### B-1 GENERAL DESCRIPTION

The 752 Power Supply receives its input from the cabinet AC power distributor, and uses it to produce the dc voltage necessary for drive operation.

The Power Supply operates at the following power source:

100 V - 120 Vac	} at 50/60 Hz
200 V - 240 Vac	

The voltage selector operates the change of input power voltage.

#### B-2 PHYSICAL SPECIFICATIONS

The dimensions of the 752 power supply are shown in Figure B-1.

#### B-3 BLOCK DIAGRAM

The Block Diagram is shown in Figure B-2.

#### B-4 POWER REQUIREMENTS

The ac power requirements with disk drive are shown in Table B-1.

#### B-5 ELECTRICAL SPECIFICATIONS

Table B-2 lists the electrical specifications of the power supply.

#### B-6 DC OUTPUT CONNECTOR

The AMP Connector with 15 pins (catalogue No. 1-480710-0) provides the disk drive with DC power. (See Figure B-3 & Table B-3.)

#### B-7 CIRCUITS

(1) Primary Circuit

The ac power filtered by Line Filter is controlled by the Power Switch (SW1) on the rear of the drive.

Filtered ac power is supplied to the Voltage Selector.

The switch SW2 of the Voltage Selector exchanges the two ranges: 100 - 120 V range (100, 115, 120 V) and 200 - 240 V range (200, 208, 220, 230, 240 V).

The ac power is protected from overload or short circuit by the fuse on the printed circuit board.

Through the Rectifiers and filter, the ac power is converted to dc power.

The converted dc power is supplied to the three Switching Circuits.

(2) Secondary Circuit

The voltage converted by the switching circuit is changed further by the isolation transformer.

Thus, the converted voltage is respectively changed to the dc voltage needed by the drive.

The cooling fan is a dc motor fan operated by  $\pm 12$  V.

(3) Protection Circuit

(a) Primary Protection

The fuses F1 and F2 are provided in the primary and located on the printed circuit board of the power supply.

These fuses are blown out and prevent the secondary disturbance in case the primary circuit or +38 V Switching Circuit are broken in the short-circuit mode.

(b) Secondary Protection

The power supply has three protection circuits for overcurrent, overvoltage and undervoltage.

When these protection circuits detect some abnormal status or abnormal operations, the switching circuits stop oscillating and cut off the outputs.

After the outputs are cut off, "ALARM" LED is lit and the Pin ⑮ of the output connector J3 is connected to the ground.

The power supply holds the protection state until the ac input is off. Turning on of the ac input initiates the power supply. If the abnormal state has been cleared, the power supply starts the normal operation.

- Overcurrent Protection

The dc output circuits are protected for over load under the operation of Overcurrent Protection Circuits within 120 ~ 300% of the rated current range.

- Overvoltage Protection

In case the output voltage rises above normal, overvoltage is detected at more than 115 ~ 135% of the rated voltage and the output voltage is cut off. (except +38 V circuit)

- Undervoltage Protection

When the output voltage goes low, undervoltage is detected at less than 10 ~ 80% of the rated voltage and the switching circuits stops oscillating.

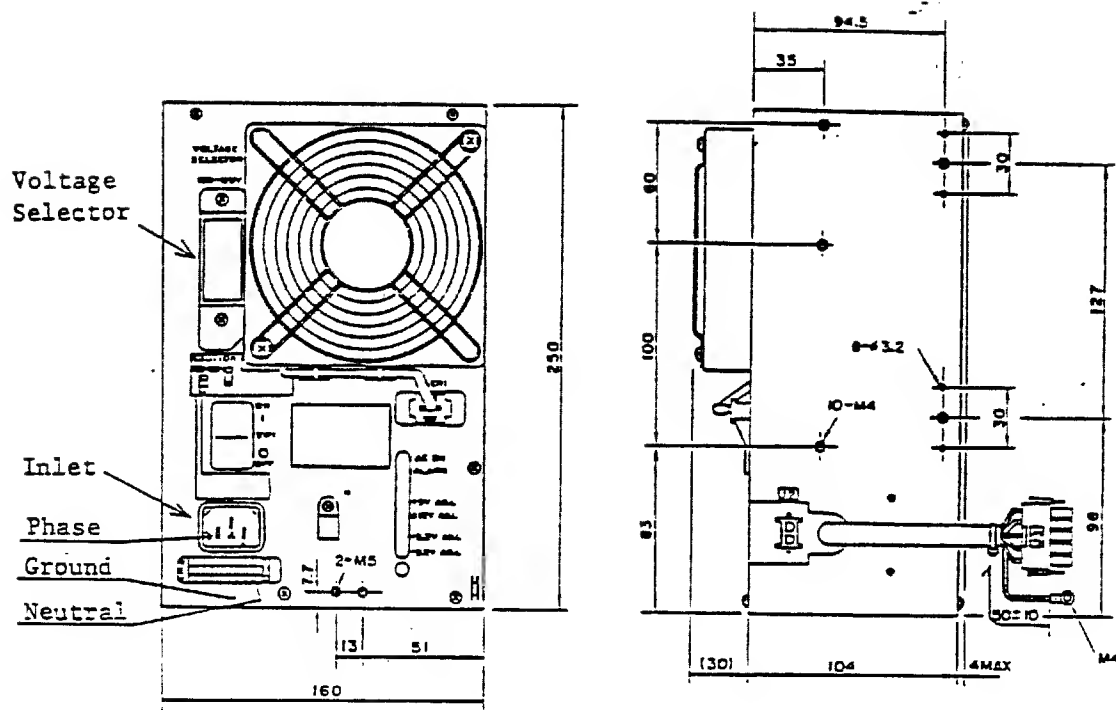


Figure B-1 752 Power Supply Dimensions

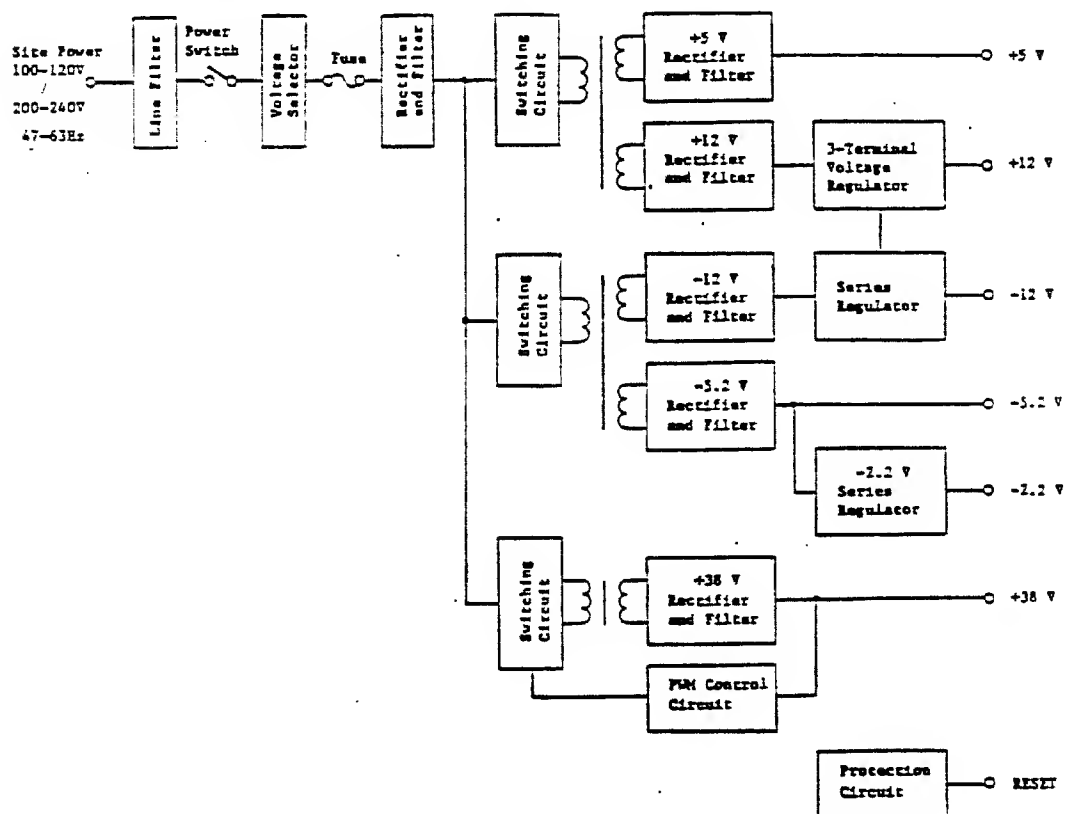


Figure B-2 Block Diagram